Rail Baltica

Document Number 1

Rail Baltica Project

Airport Integration Study

(Passengers and Luggage Services)

Feasibility study – Final Report

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Final version

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Rationale

Assignment Order identification

Consultancy Services: CEF[1] Agreement No INEA/CEF/TRAN/M2014/1045990o – A34. (13th of March 2018)

Framework contract agreement for the provision of the expert services No 8/2017-120-6/4 dated November 24, 2017

Name of the expert to implement Assignment Order: Alain GAUDRY

Assignment order is covered in the following Field of expertise: Railway Business Development

Brief description of the assignment

The "Airport Integration Study (Passenger and Luggage Services)" feasibility study to be provided by the Consultant aims to evaluate the essential features and requirements for the integration of airport passenger traffic with the Rail Baltica Global Project. Mainly it shall provide a service description, a forecast of usage, and recommendations to instruct the detailed design for railway stations (not including an implementation plan).

The airports to be considered are Tallinn, Riga, Vilnius and Kaunas ("the Airports"). The stations to be considered are Tallinn, Pärnu, Riga, Riga Airport, Panevėžys, Kaunas and Vilnius. It is to be assumed that combined ticketing will be possible; other services and options will be reviewed in a Workshop phase.

Following the terms of reference of the assignment order, the feasibility study implemented by the Consultant is developed in 2 main phases including 2 reports, the interim report and the final one;

The present document, the Final report, includes the following Work Packages as requested in the ToR.

[1] Grant Agreement under the Connecting Europe Facility (CEF) -Transport Sector Agreement No INEA/CEF/TRAN/M2014/1045990

WP 4	Recommendations for Rail Baltica
4.1	High-level description of services that can be offered, including from passenger perspective
4.2	Overview of typical implications for station infrastructure and operational requirements for such services
4.3	Overview of typical requirements on rolling stock design, operation and maintenance. Analysis of impact of CAPEX, OPEX and LCC.
4.3	Overview of typical security arrangements and any current regulatory or "common practice" requirements for passengers and luggage on international rail services
4.4	Brief overview of any implications for air-rail passenger services of the Graz Declaration and similar EU policies, specifically but not exclusively with regard to the promotion of regional passenger migration from air to rail
4.5	Description of luggage transfer options (including any container or storage/pallet to be used) and discussion of whether one common approach can be used for all of the Airports or what specific considerations exclude that in particular cases
	Recommendations for station - airport transfer mechanisms in each case, and implications for services or infrastructure (including security in transit, automation and bag tracking services) • Including transfer route and transit mechanism (conveyor, trolley, vehicle) between station and airport, with specifications where any impact on infrastructure
4.6	Discussion of implications for station infrastructure, including but not limited to any requirements for secure operational areas and for luggage processing, transit or storage areas, and passenger "wayfinding" considerations
	Requirements for luggage management within stations (including "check in", security processes, process automation and bag tracking aspects)
	Requirements for station infrastructure (including any differences between each of the stations serving Airports)
4.7	Recommendations for any changes to Design Guidelines
4.8	Detailed description of any implications or requirements for rolling stock, including but not limited to the use of modified passenger vehicles
	Recommendations for rolling stock

Table 1. Work Packages included in the Final report

It should be noted that this report can be also considers to other inputs presented in the Interim report including the following WPs:

WP 1	Global Best Practices
1.1	Identification of similar services worldwide and possible best practices from the point of view of Service Providers field of expertise
1.2	Overview of typical implications for station infrastructure, rolling stock and operational requirements for such services
1.3	Overview of typical security arrangements and any current regulatory or “common practice” requirements for passengers and luggage on international rail services
1.4	Brief overview of any implications for air-rail passenger services of the Graz Declaration and similar EU policies, specifically but not exclusively with regard to the promotion of regional passenger migration from air to rail
WP 2	**Rail Baltica Context**
2.1	Preliminary Market Analysis (based on Rail Baltica and Airport data and forecasts), and for both passenger numbers and probable luggage volumes: • International (excluding regional) passenger traffic volumes at the Airports) • Regional passenger flows (between the Airports, etc.)
2.2	Usage forecasts 2026-2036, 2036-2046
2.3	Description of layout and possible routes or corridors for connecting Rail Baltica to each of the Airports
2.4	Discussion of services to be offered (ticketing, code share, forms of reprotection agreement, others)
2.5	Scope for potential extension of service(s) beyond Air-Rail: • interstation checked luggage (e.g. Tallinn – Vilnius) • potential integration with other modes (e.g. delivery to passenger vessel) • potential integration with “left luggage” service • potential integration with third party services (for example, AirportR and various services offered in Hong Kong)
WP3	**Technical Feasibility and Implications for Rail Baltica**

3.1	Discussion of implications for operations and systems, including but not limited to such considerations as implications for rolling stock, possibility of using modified passenger vehicles, direction of travel, side for loading, and related points
3.2	Description of any particular "problem areas" including but not limited to luggage handling and management or check-in processes
3.3	Description of spatial requirements in stations, including secure areas.
3.4	Achievable target time for transfers for the options described

Table 2. **Work Packages included in the interim report**

The Interim report results have been presented during several working meeting on site the 08th and 09th of June 2019 including Riga airport meeting.

Following the submission of this Final Report to RB and its review, it could be necessary to organize another workshop session to be conducted at RB Riga office where it would be discussed the main final results, the review work to date and Discussion of planned station infrastructure and implications of these services for that infrastructure.

Documents considered for this assignment

The following documents have been provided by RB and have been considered by the Consultant:

- Design Guidelines for Rail Baltica railway, General requirements; 38 pages, performed by SYSTRA, 2018
- Design Guidelines for Rail Baltica railway, Stations and Passenger Platforms requirements; 28 pages, performed by SYSTRA, 2018
- Operational Plan Concept for Rail Baltica railway, ETC Gauff Mobility, 2018
- For supporting information, Service Provider can refer to public information on Rail Baltica documentation library (http://www.railbaltica.org/about-rail-baltica/documentation/), specifically:
  - Cost-Benefit Analysis, 2017, EN;
  - AECOM Rail Baltica Final Report, 2011, EN;
  - AECOM 2014 – Feasibility study– Analysis of Kaunas Vilnius Extension;
- Commented versions of the Interim Report;
- Consultant's notes from meetings.

List of abbreviations

Abbreviations	Meaning
ATR	Automatic Tag Reading
BHS	Baggage Handling System
CDM	Collaborative Decision Making (CDM) airport provides the full set of Departure Planning Information messages.
GARA	Global AirRail Alliance
GH	Ground Handling Company
IARO	International Rail-Air Organization
IATA	International Air Transport Association (IATA) supports aviation with global standards for airline safety, security, efficiency and sustainability
IM	Infrastructure Manager
IT	An 'IT solution' is a set of software programs and/or services that vendors, channel partners and value-added resellers deliver to customers
EMU	Electrical Multiple Unit (rolling stock trainset)
PRM	Persons with Reduced Mobility
RB	Rail Baltica project
RFID	Radio Frequency Identification
RU	Railway Undertaking
ToR	Terms of Reference of the Assignment Order
TSI	Technical Specification of Interoperability
WP	Work Package

Table 3. **List of abbreviations**

Definitions

First of all, for a better understanding of this feasibility study, the following definitions are provided to facilitate their meaning when mentioned in this report:

- **Airline check-in[2] of passenger:** the process whereby passengers are accepted by an airline at the airport prior to travel. The airlines typically use service counters found at airports. The check-in is normally handled by an airline itself or by a handling agent working on behalf of an airline. "Online check-in" is the process in which passengers confirm their presence on a flight via the Internet and typically print their own boarding passes (or simply carry on mobile devices). This possibility is nowadays used in an extensive way mainly because passenger have the choice to reserve some seats according to their preference (along the window, in front or rear of the plane, etc.) and avoiding queues**.** In some Cities, in-town check-in is offered by some airline companies and at many places, luggage check-in is also offered.
- **Airline check-in of luggage**: similar as for passenger airline check-in. Passengers usually hand over any baggage that they do not wish or are not allowed to carry into the aircraft cabin and receive a baggage tag before they can proceed to board their aircraft. If a luggage has passed the airline check-in (registration, production of luggage Identification tag, quantity, size / weight control), the airline company assumes the full legal responsibility following the airline's own and various international regulations and conventions or agreements. The airline shall take measures for transportation of the checked-in baggage to be on the same aircraft as the passenger and in particular if applicable legislation requires presence of the passenger during fulfilment of customs clearance procedures related to checked baggage. There is also a possibility to have unaccompanied baggage (in this study that term shall mean baggage accepted by the airline for transportation on board of an aircraft without an accompanying passenger). Nevertheless, if a passenger does not show up for the flight ("No-Show"), any of their luggage already loaded aircraft must always be removed from the aircraft.
- **Drop-off luggage:** the option to drop-off luggage at a desk for registration but also the airport concept of "drop-off desks". In most of cases "drop-off desks" in airport are also "check-in desks". Some airlines have a self-check-in process allowing passengers with bags to airline check-in desks supposed to be only for luggage for passenger having already performed the airline check-in procedure. It is existing also self-luggage-drop-off machines and passengers shall then attach the baggage Identification tag and drop the bag at the baggage drop belt.
- **Luggage:** which, once checked- in the departure airport, is neither accessible to the passenger during the flight nor at the stopover if there is one. This luggage is carried in the baggage hold of the plane (Assuming the two airlines have at least interline agreement, i.e. it is not always possible to check the bag all the way to the final destination).

[2] https://en.wikipedia.org/wiki/Airport_check-in

- **Carry-on baggage:** Luggage brought into the cabin of the plane by the passenger.
- **Code-sharing:** A code-share agreement is an arrangement where two or more airlines share the same flight. A seat can be purchased from an airline on a flight that is operated by another airline under a different flight number or code. Most of major airlines have one or multiple code-share agreements.
- **Interlining**: also known as interline ticketing and interline booking, is a voluntary commercial agreement between individual airlines to handle passengers traveling on itineraries that require multiple flights on multiple airlines. Such agreements allow passengers to change from one flight on one airline to another flight on another airline without having to gather their bags or check-in again.
- **Luggage registration**: in this report, "luggage registration covers only the registration of luggage for transport storage excluding the airline check-in procedure. The main difference between "registered luggage" and "airline checked-in luggage" is the entity which is legally assuming the responsibility for that luggage: if "registered" it is the railway operator (or other carrier), if "airline checked-in", it is the airline.
- **Luggage identification tag (or bag tag)**: once it has passed the airline check-in, luggage is considered to be identified and registered in the airport and airline system (tag registered). Current bag tags include a bar code using the Interleaved 2 of 5 symbology. These bag tags are printed using a thermal or barcode printer on an adhesive thermal paper stock. This printed strip is then attached to the luggage at check-in, allowing automated sorting of the bags with the aid of bar code readers. Several IATA Resolutions are covering the luggage (IATA Resolution n° 740 Form of Interline Baggage Tag, and Resolution n°753 Baggage Tracking).
- **Airport luggage (or baggage) handling system (BHS)**: is a type of conveyor system installed in airports that transports airline checked-in luggage from ticket counters to areas where the bags can be loaded onto aircrafts. A BHS also transports checked baggage coming from aircrafts to baggage claims or to an area where the bag can be loaded onto another aircraft. Although the primary function of a BHS is the transportation of bags, a typical BHS will serve other functions involved in making sure that a bag gets to the correct location in the airport. Sortation is the process of identifying a bag and the information associated with it, to decide where the bag should be directed within the system.

Illustration 1. Airport's luggage handling system (BHS)

- **Railway-airport express-shuttle train:** generic term used in this report to identify the last part of the railway journey trip. Generally connected to the national railway system with dedicated railway express shuttle trains (in most cases) and direct railway services to the airport. Some example: Heathrow Express (London), Aero-express (Moscow), Hong Kong MTR airport express, Taipei with MRT A.

- **Railway express shuttle train station:** Generic term used in this report to identify in this report the last station of the railway network, where railway-airport express train departure and arrival are located. Typically, Paddington station in London and Heathrow railway-airport stations.

- **Railway "regular" station:** generic term used in this report, any station of the railway network which is not including a specific railway express shuttle train station.

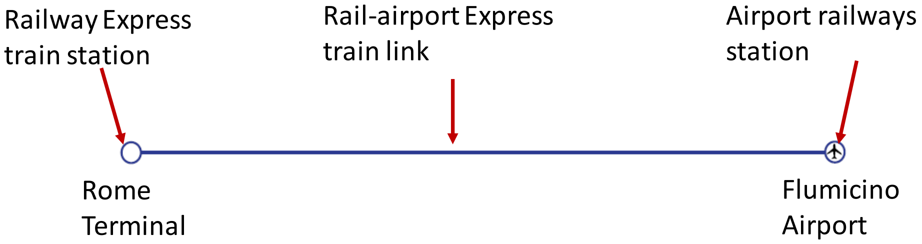


Illustration 2. Railway-express shuttle train services (Rome – Trenitalia – Leonardo Express)

- **Rail & flight services:** generic term used in this report. In general, all passengers travelling using rail and air solutions in a trip from an Origin to a Destination. They can used rail & flight combined tickets or not and be more and less concerned by rail-airport integrated services.

- Rail & flight combined ticket: A single ticket combining 2 trip segments (rail and flight).

WP 4: Recommendations for RB

WP 4.1 -High-level description of services that can be offered

Overview of what is proposed Worldwide:

Rail-airport integrated services for passengers:

Combined tickets Rail & Flight are nowadays proposed in a lot of countries and railways (SNCF, DB, Renfe, Belgian Railways/SNCB). Common practices are to travel with only one rail &flight combined ticket including both rail and air segments according to and limited by the partnership agreement between the railway operator and airline companies: no all airlines and flight destinations are offered, and it is firstly a partnership agreement between the railway operator and airline companies.

It is observed that this service combining the 2 trip segments in a single ticket is sometimes confused with rail-airport integrated services (scope of this feasibility study). This single is issued with two "boarding passes": one for the flight and another for the train journey. The price of the train ticket to the final destination is usually included in the airfare. Tickets can be purchased either by internet or by vending machines in stations. Finally, there is no real "physical" impact on railway stations, train and airport, mainly to establish IT interconnection link between the electronic ticketing airline and railway databases (like with Amadeus system). It cannot be therefore considered to be part of the rail-airport integrated services solution to be defined.

To offer passenger-check-in possibility in railway station cannot be considered to be a major issue (and it was abandoned as example by DB / Lufthansa Rail&flight program) because most of the passengers are using (or can use), on-line check-in by internet.

Rail-airport integrated services for luggage:

Offering rail-airport integrated services for luggage is a more complex issue. Two main alternatives for rail-airport integrated services have been identified from the above examples. Main difference is that the **"rail-airport partial integrated services" alternative** is not including airline check-in services and **the "rail-airport full integrated services" alternative** is including this possibility. The following table aims to assess and compare the different alternatives by main "elementary transport chain segments".

Both directions are considered (the outward direction home to airport by railway and return airport to home by railway). Some segments are common for all alternatives or specific to each alternative or/and limited to some direction.

It is reminded that difference between the partial and full integrated services is that partial services are not including airline check-in possibility.

Among the different full integrated service examples, it was identified that these services, for the most successful ones, are mainly offered in airport-railway stations (the last railway station before reaching the airport by a shuttle train).

It is reminded that full rail-airport integrated services shall be considered for both directions of the railway-airport-full trip: from door to airport, but also from airport to door. Therefore, passengers are users of Full integrated services from door to airport and partial integrated services from airport to door (no luggage airline check-in).

The following table shows what are main differences between partial and full rail-airport integrated services:

Nbr	Transport chain segment / actions	
	Rail-airport partial integrated services	Rail-airport full integrated services
	Limited to drop-off / pick-up railway services	Full integrated rail-airport services
A1 - both directions	Drop-off, pick up, registration of luggage at a registration desk in railway station - Drop-off and registration of luggage only. No specific other devices related to security checks which will still be done at airport.	**Integrated railway-airport integrated services.** Same function as partial integrated service + check-in procedure for passenger and luggage (tag registration) for outward direction
A2 - both directions	Storage of luggage in railway station, storage room, protection against loss, theft, vandalism and un-authorized access	
A3 - both directions	Transport of luggage to the railway station platform from / to the storage room. Protection against loss, theft, vandalism and un-authorized access	
A4 - both directions	Loading / unloading luggage on / from trains board from / to platform	
A5 - both directions	Transport of luggage from / to railway station to / from airport, same train as the passenger preferably (to prevent to have dedicated additional luggage management operation (from / to home to / from railway station). Protection against loss, theft, vandalism and un-authorized access	
A6 - both directions	Loading / unloading luggage on / from trains board from / to platform	
A7 (station to airport only)	Transport of luggage from railway station platform to the storage room in railway-airport station	Transport of luggage from railway station platform to the Airport's luggage handling system (BHS) or storage room eventually
A7 (airport to station only)		Transport of luggage from the Airport's luggage handling system (BHS) to the storage room in airport railway station (buffer zone). The "buffer zone" is required to perform baggage sortation according to passenger train destinations
A8 - both directions	Storage of luggage in airport-railway station in storage room	Storage of luggage in airport railway station. (return direction only)

Nbr	Transport chain segment / actions	
	Rail-airport partial integrated services	Rail-airport full integrated services
	Limited to drop-off / pick-up railway services	Full integrated rail-airport services
A9 (airport to station only)	Not required	Transport of luggage from the storage room of airport-railway station to platform, followed by segments A6 – A5—A4- A3 – A2 – A1
A10 - both directions	Passenger himself. Drop-off or pick-up luggage to the registration desk in the railway-airport station	Not required
A11 - both directions	Passenger himself. Carrying luggage from the registration desk in the railway-airport station to the check-in desk or drop-off desk in the airport	Not required

Table 4. **Transport segment chain, rail-airport integrated services (full and partial)**

Rail-airport full integrated services are mostly worldwide implemented but this service is mainly based on the concept of "satellite" check-in desk of the airline, managed by the airline (or by a company having a delegation of responsibility) located only in airport-railway express train stations.

When the rail-airport integrated service has been extended to other stations of the railway network, in a wide sphere, it was abandoned few years mainly for financial reasons. If some rail-airport services are still implemented elsewhere than in airport-railway express train stations (in high speed train stations, as example), they are mainly limited to partial integrated services (no airline check-in implemented). The railway is only managing the transport logistic aspects without really interfering with airport and airline process, IATA resolutions, Airport CDM, duties, etc. Transport of luggage (or parcels) is (or was) a classical core business of railways, existing for years, whether it is between railway stations and airport or between railway stations themselves. In case of limited services without luggage check-in in railway station, nevertheless, rail air trip "synchronization" is a specific issue, because the luggage is supposed first to arrive "on time" before the flight departure (minimum 40mn) but also not supposed to be stored several days before this flight departure.

It shall also be considered that the concept of a rail-airport luggage integrated service shall not limited to one direction of the trip (home to airport) but also the return trip (airport to home) and both alternatives shall be implemented:

- Home to airport: Full integrated services alternative
- Airport to home: Partial integrated services alternative (= Full without check in).

Comparison of alternatives:

Despite that from the simple logistic and physical aspects may look quite similar, external factors and regulations shall be taken into consideration for the comparison of alternatives.

Rail-airport partial integrated services:

Rail-airport integrated services is limited to drop-off, pick-up luggage at railway stations and offering enabling a hassle-free railway journey with added value for passengers. For airline check-in, luggage are picked up by the passenger at the railway airport station and following the classical process of luggage check-in at airport. In some way, the railway operator is only a “luggage carrier” not really involved in the airport activity and business. It is also obvious that some desks in stations will be required, some recording / tracking process, handling, loading and unloading on train board system, safety system to avoid luggage being stolen, pilfered or suffering other interference (in general what is called “logistic” components in this feasibility study).

Rail-airport full integrated services:

Rail-airport full integrated services are high-class range of services offered as example in Hong Kong including check-in procedure. Compared to partial integrated services, logistic aspects are quite similar but made more complex because luggage shall be controlled, registered (tagged), transported and tracked following IATA Resolutions in order to be accepted/acquired by the transfer service operator in the airport.

This alternative is obviously more attractive for passengers. Most of them are now using “on-line check-in” systems and are nevertheless obliged to queue at the airport check-in (or drop-off luggage desk) only for the purpose of luggage hand-over.

Luggage Restriction issues:

Another cost driven trend that is clearly visible is the change in luggage handling practices by the different airlines. Many airlines, mainly the low-cost company, are trying to reduce the amount of hold luggage by restricting the allowance of hold luggage or by charging a fee for any hold luggage passengers wish to check-in. Another issue is that airline companies are applying more or less restrictive and specific rules. It explains that some off-airport counters are accepting luggage for some companies only and not accepting all luggage.

Stakeholders identification:

Introducing a rail-airport integrated solution involves, as every large project, different stakeholders, each having different interests and goals. In this section, the most important stakeholders in the integration process are identified. Main objective is also which are the respective motivations of each stakeholder to set-up an integrated solution. Especially airport, airline, railway and passengers can be decisive in the process.

Passengers are important because they will be the end users and end users are decisive for the success of the service concept. Airport, railway and airlines are important stakeholders because the service could be executed for and possibly by the airport, railway or airline usually on a format of partnership. These stakeholders are Decision Makers as to whether or not the service will be implemented.

- **Airport** – One of the most obvious stakeholders is the airport under consideration. Part of the process that is traditionally performed at the airport, namely the luggage check-in procedure or and drop-off, will be performed at a remote railway location. This will affect airport processes. In some extent it could also lead to some "business" case issue, the airport considering that, whatever will be the disposition implemented by the service operator for (check-in, security control…) it will not be reliable and shall be achieved again at the airport (and RB shall pay for that). It could also lead to consider any change, any other operation of handling / sortation of luggage other than the traditional check-in desks or reception belts to be an opportunity for asking RB to pay some fees.
- **Airline** – One of the main important stakeholders to be considered is the airline (or airlines) involved in the processing of luggage, especially for the full integrated services case. Luggage check-in at the terminal desks is an activity that is usually performed by Ground handling (GH) companies' staff. Airports provide equipment-infrastructure (for check in, BHS, CUTE... operations), that GH companies perform and charge airlines. One of the main issues is to identify if RB could be considered as being similar as an airline company (using trains instead of aircraft) and luggage only in transit at the airport having been previously received safety and security control. In this case, as for any airport, RB shall show evidence that all procedures, equipment of the luggage transport chain are compliant with the regulations in force. Despite of this, it could be also a matter of "trust", the airline considering in any case that some risk could exist.
- **Passengers** –Passengers departing from the specific airport are stakeholders in the process. They will be the eventual users of the off-airport luggage check-in facility at remote railway locations and can be more and less interested by rail-airport integrated services. Typically, business travelers, carrying only hand-luggage will not see any interest. On another hand, people with reduced mobility will be more attracted by these services having the possibility to travel relieved from their luggage.
- **Railway Operator**– If passengers can travel to the airport without the hassle of carrying their hold-luggage, they might be more willing to use Rail Baltica services to access the airport. Thus, introducing off-airport luggage check-in services at remote railway locations can have an effect on the number of passengers using the train and on RB operations.
- **Facility Host** – Railway stations can be only the host of the off-airport luggage check-in facility and the operations at the train station will be affected by the presence of the luggage check-in facility.
- **Logistic provider** – In some off-airport luggage check-in solutions identified above, external companies were involved to perform part of the process. Such a company can be called a third-party logistics provider. For example, it was observed especially when the rail-airport integrated service is limited to railway express trains, some private companies using vans or small trucks are handling luggage.

- **Customs**- In the area without internal frontiers of the EU, it is important to ensure freedom of movement of intra-EU travellers luggage. To this end, rules had to be introduced in order to organize controls on luggage coming from or going to other countries.

- **Other stakeholders** – Airport activities involve also several other stakeholders mainly for the management of security aspects and immigration control issues. Governmental and country administration can also be involved mainly for all issues related to security, safety, deliverance of authorization, etc. Environmental organization interested to promote transport mode limiting greenhouse effect.

Interests of stakeholders:

The interests of the above stakeholders to set up rail-airport integrated system differ and are not only driven by financial aspects:

- **For airport:** possible benefits for the airport in introducing rail-airport integrated services include offering an additional service to passengers, which complies with the new modern marketing strategy. Introducing rail-airport integrated services can increase the terminal and luggage handling capacity (if located appropriately and implemented in a flexible manner) of the airport by reducing the peak-loads due to early luggage collection. The solution can have a positive effect on the airport's corporate image because it is innovative and can possibly promote usage of public transportation to the airport. As mentioned before, it could be also considered by airports that RB' rail-airport service integration is an opportunity to develop some new business (RB shall pay the airport or / and GH companies for handling, sortation of luggage, storage or any other party according to contractual dispositions …).

- **For airlines:**

  Airlines can also have interests and goals in participating in an off-airport luggage check-in solution, operational advantage because peak loads can be reduced by early luggage collection, the stimulation of public transport usage and thereby creating a positive corporate image and increasing the catchment area.

  Many attempts to introduce rail-airport integration services have failed to establish some partnerships in the initiation phase. Mostly, these failures occurred because of different interests among the many different stakeholders involved, as described above. Especially problems with reaching agreements on the funding of the projects have been a significant factor in inhibiting the launch of rail-airport integrated services solutions. To assure quality of service for passengers, detailed service level agreements need to be developed between the parties involved in providing the overall solution. The main condition for success is not disturbing the existing check-in process (luggage and passengers) implemented by airlines, airports and clear responsibilities. Code-sharing agreement will be probably the easiest way to set-up partnerships relations and railways station registered with an IATA code in order to make possible passenger and luggage check-in in stations.

- **For passengers**:

It is important to take passenger expectations and concerns into account in developing rail-airport integrated luggage services. Different passengers will have different expectations. Business class passengers will expect high service levels, while other passengers might expect low prices. There are no currently any state preference surveys available to assess how such system is attractive for passengers and how much they would be ready to pay according to a full or limited service.

Concerns passengers might have can be about mishandled bags: a common misconception is that any additional transfer of luggage from the check-in point or drop-off point to the airport results in higher rates of mishandled bags and additional costs. It is necessary to reassure passengers that rail-airport integrated services will not result in higher rates of mishandled bags, increased risk of damage or unacceptable additional costs.

- when rail-airport integrated service meets passengers' wishes, the service can add value for the passenger (who is also a customer) for several reasons:
    - More convenience during the journey to / from the airport;
    - Less stress during the journey;
    - Generally; more reliable time schedule than by private cars and buses (traffic jam)
    - Easy and eco-friendly usage of public transport to the airport;
    - Possibility to have less waiting time at the airport before departure.
- **For railway operators:** participating in rail-airport integrated service can help increasing the number of passengers traveling by train to airport, thereby generating more revenue. The solution can have a positive effect on the railway's corporate image because it is innovative and can possible promote usage of public transportation to the airport.
- **Facility Host:** interests of railway stations, if limited to provide some space for a check-in counter is mainly financial ones; facilitating the luggage check-in service location will result in additional revenue for the host of the facility.
- **Logistic provider:** not a main stakeholder, financial interest.
- **Customs:** as far as customs are not business-oriented entity, it could be considered at the first approach they should not have any specific interest or opinion regarding rail-airport integrated services, just to respect the International rules in force. Nevertheless, if the railway trip is considered as the last part of the transport trip coming from outside the EU, the last part of the combined air-rail trip by train being considered to be covered by a code-share agreement (please refer to customs aspects in the following chapter), customs controls must be performed at the arrival railway station or the railways station shall not equipped for air traffic with third countries.

- **Other stakeholders:** it has not been identified any specific interest regarding immigration control which is performed at airport in any case. Security control are mainly sub-contracted by airline to airport or outsourced. Governmental organization are interested to implement safe and security control check and to deliver the relevant authorization. Environmental organization will mainly focus on the development of transport segments including transport means limiting greenhouse effects.

Airport Opinions

Interfacing with airports is a key issue for this project as a lot of physical interfacing components shall be considered as pathways for passengers and luggage transfer, loading and unloading area, security aspects, etc.

Main airport representatives of each Baltic Country have been met during specific working meetings (Riga, Tallinn, Vilnius) in order to identify for each airport if specific issues shall be considered. It was also the opportunity to assess current extension project developments and synergy with RB projects.

- **Riga airport**

Riga International Airport RIX is currently accommodating about 17 airlines companies with more than 80 international destinations (100 during the summer-time).

Illustration 3. Flight destinations from Riga airport

Riga airport traffic is showing a regular and significant growth for the last 15 years reaching a volume of about 7 million of passengers in 2018[3].

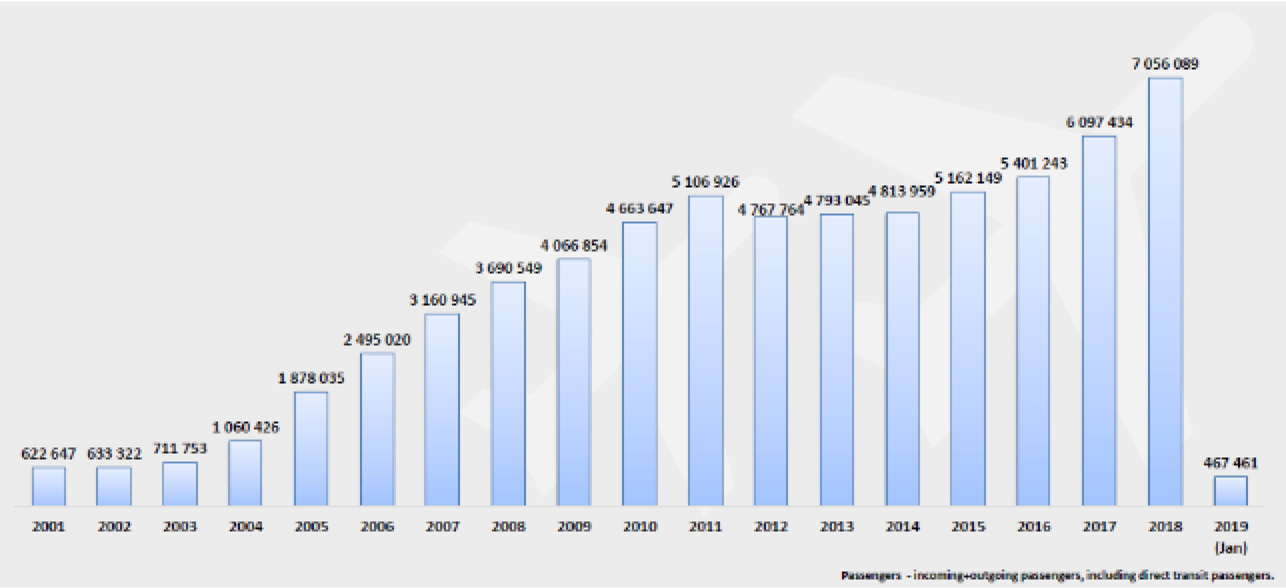


Illustration 4. Riga Airport (RIX) passenger traffic

It is interesting to show that the current traffic is *already* higher than what was planned in year 2015 in the business plan of the airport.

3 http://www.riga-airport.com/uploads/files/Partneriem/aviacija/statistika/2019/1_RIX_Statistics%202019_JAN.pdf

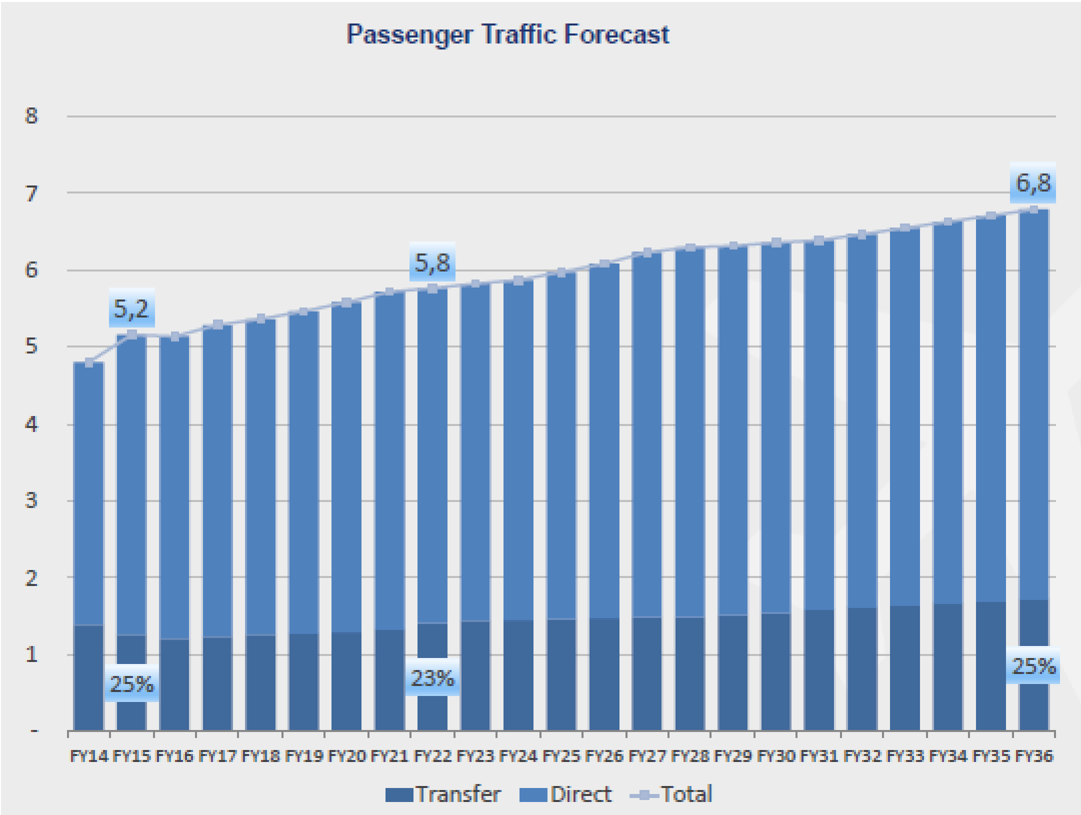


Illustration 5. Riga Airport (RIX) passenger traffic forecasts (Business plan year 2015 – 2036))

According to Riga airport statistics, about 28% of the passengers are travelling through Riga airport in transfer or transit. So, in simple words, it means that only 72% of the total airport passenger traffic (5 million) shall be considered.

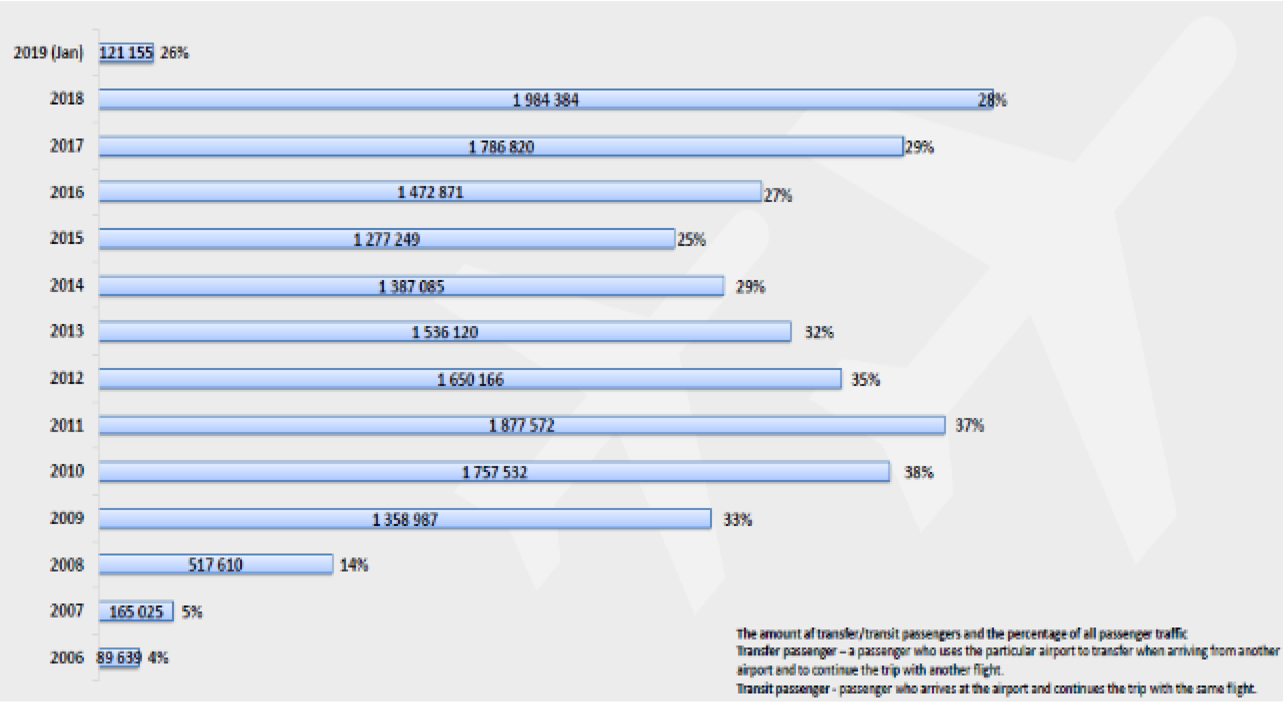


Illustration 6. Transfer / transit breakdown at Riga International airport

With the following breakdown of destinations:

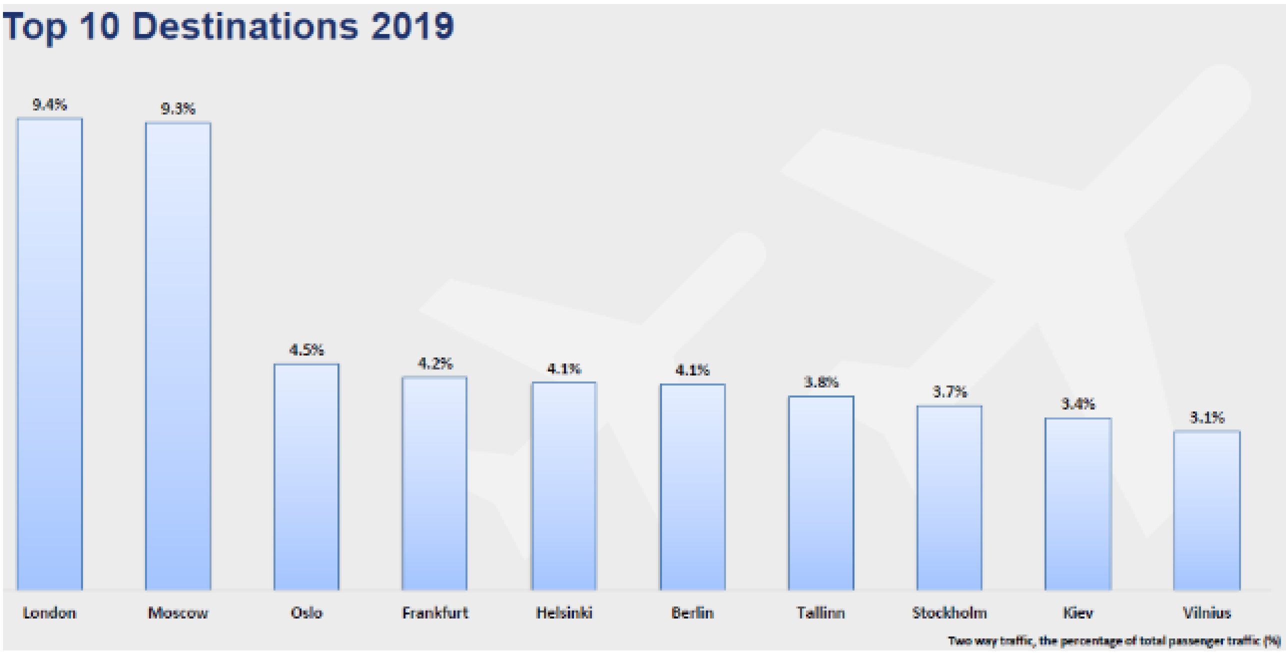


Illustration 7. Most popular destinations (top 10)

London and Moscow are the most popular destinations from Riga Airport. It is observed also that Tallinn and Vilnius Cities represent respectively 3,8 and 3,1 % of the traffic (6,9 % in total) which is a negligible part of the traffic.

Riga airport has engaged regular terminal extension works (2015-2016).

In 2019, RIX has begun the implementation of stage six of its terminal expansion, under which a new public terminal and related infrastructure will be constructed. The new terminal will in the future also be connected to the long-awaited Rail Baltica rail line, easing connections through the Baltic countries, Poland and Finland[4]

Illustration 8. Riga International airport extension project integrating RB connection (source RIX Business plan 2015 - 2036)

During the working meeting (08/04/2019), main issues raised by RIX airport representatives were:

- As the station will be integrated inside the RIX buildings and very close, if the volume of luggage is significant, deliver by a conveyor belt should be considered;
- Clear responsibility shall be defined between RB and Rix airport;
- Custom clearance aspects (at arrival) shall be considered (in airport, in station ?) as well as security aspects;
- Marketing aspects shall be more developed, airport will be pleased to be involved in order to offer better services

[4] https://standbynordic.com/riga-airport-in-fastest-ever-development/

- It could be planned to have only a single point entrance / exit connection between RB and RIX terminal structures for luggage transfer
- In general, other areas, source also of business development shall be considered as parking slots
- Sortation of luggage is still manual but in close future it will be fully automatized.
- Passenger and luggage flows are different, so the design study shall take into account
- IATA registration of railway stations concerned by rail-airport integrated services will facilitate luggage sortation and handover aspects.

As conclusion: Riga RIX airport is quite well informed regarding the issue RB railway station integrated in the extension project. Nevertheless, it is recommended to keep close relations, communication, coordination works between the development of RB station design, including rail-airport integrated services and development plans of Riga RIX airport.

- **Tallinn airport**

Tallinn Airport is the largest airport in Estonia and is open to both domestic and international flights. It is located 5.0 km south-east of the center of Tallinn on the eastern shore of Lake Ülemiste. It was formerly known as Ülemiste Airport. Tallinn International Airport is currently accommodating about 16 airline companies with more than 35 international destinations.

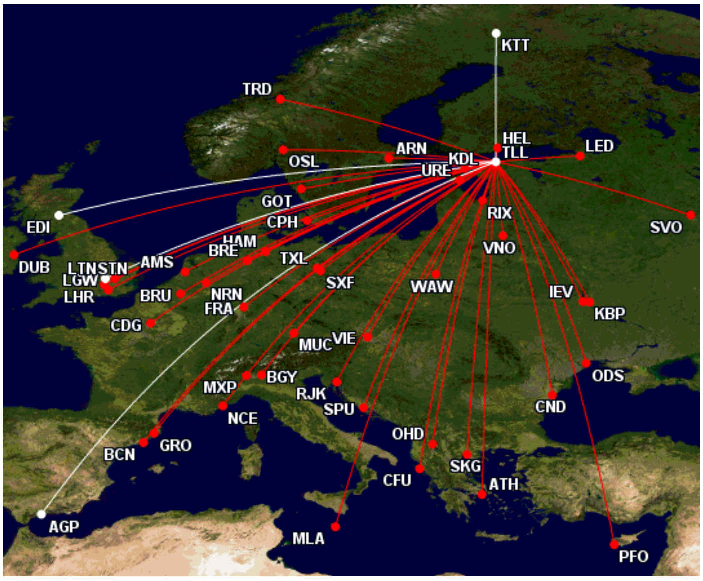


Illustration 9. Flight destinations from Tallinn airport

Tallinn Airport passenger traffic was about 3 million passengers in year 2018 and no transit or transfer or passengers is accounted. Direct flight services to and from Vilnius and Riga are also offered

The vision of Tallinn Airport by year 2035 includes expansion of the passenger terminal for serving up to 6 million passengers, and construction of the airport city.

The need for expansion is based on constant increase in the number of passengers. The current passenger terminal has been built for 2.6 million passengers, and already last year Tallinn airport crossed the line of 3 million passengers. In the past five years, the number of air passengers has increased by 50%, i.e. by one million people.

In 2035, the expanded passenger terminal of Tallinn Airport will be able to serve 6 to 8 million passengers per year. The terminal area will be nearly three times larger, reaching to 85,000 square meters instead of the current 34,000 square meters. The number of passenger gates will double – from thirteen to twenty six.

The construction work is planned in stages, according to the possibilities of the business environment and based on the estimated number of passengers.

Illustration 10. Tallinn airport extension project (sketch, source Tallinn airport)

During the working meeting (10/06/2019), main issues raised by Tallinn airport representatives were:

- As RB station will be not so close to the terminal, tramway line could be considered for the transport of luggage. Passengers could walk;
- The same system as in Riga station planned (with conveyor belt) could be also an alternative for luggage (despite the 500m length);
- Cargo transport for other goods is also an issue to be considered as part of RB services;
- It is planned in the future to have the tramway station underground, part of the terminal extension;
- Rail-airport integrated services shall be developed on robust traffic forecast model and business case including sensitivity for price. Most of passengers could be for business purpose with passenger travelling with few luggage.

Conclusion: there is also a need to share information with Tallinn airport representatives. Current terminal extension project is not taking a specific care in general about RB station development and moreover about the specific case of rail-airport services integration.

- **Vilnius – Kaunas airports**

Vilnius Airport is the international airport of Vilnius, the capital of Lithuania. It is located 5,9 km south of the city. It is the largest of the four commercial airports in Lithuania by passenger traffic, with more than 4.9 million passengers in year 2018. Vilnius saw a large increase with 17% more than the previous year. According to Vilnius airport statistics, transfer and transit of passenger is very low, in the range of 0.05%[5].

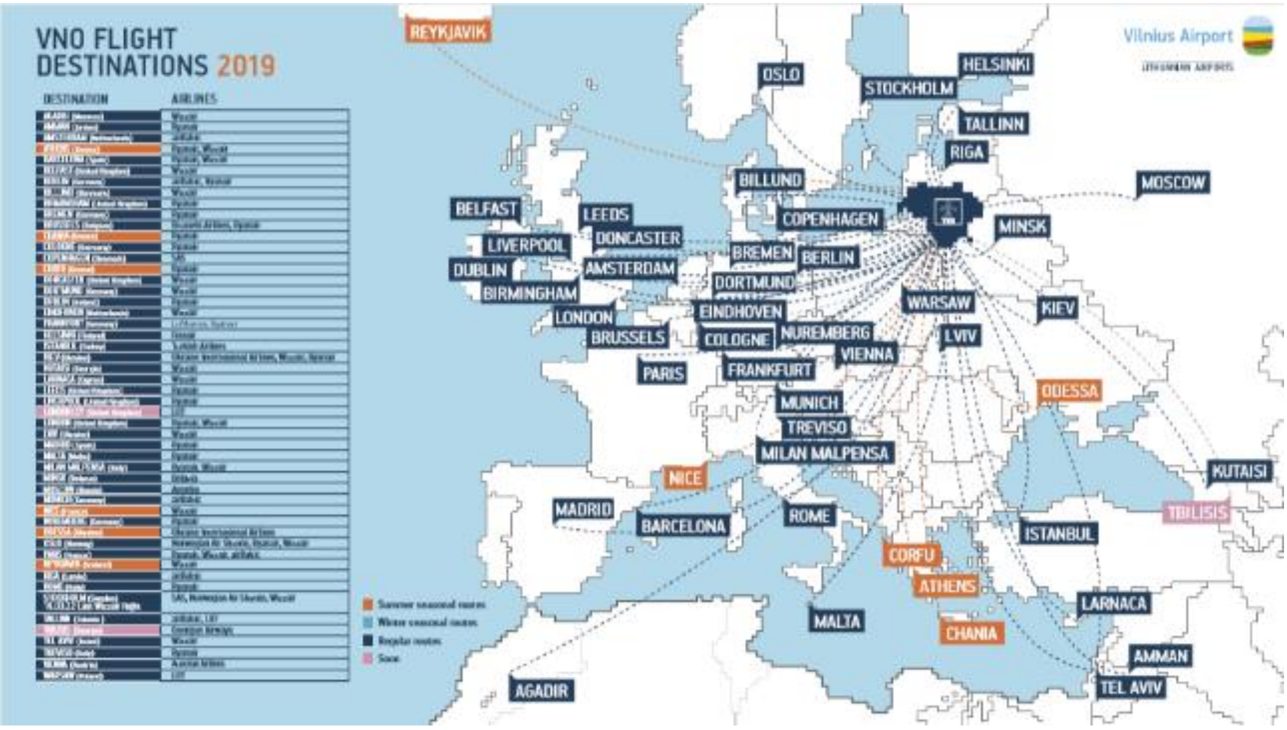


Illustration 11. Flight destinations from Vilnius airport

Vilnius International Airport serves as a base for about 20 airlines companies and is offering between 40 and 50 different flight destinations (according to seasonal needs).

Vilnius Airport's infrastructure is no more adapted to the existing passenger flows. The current terminal building, which was opened in 2007, has a capacity of 3.5 million passengers per year. However, in 2016 and 2017 passenger traffic grew to almost 3.8 million per year to reach 4,9 in year 2018. Extension of the passenger terminals are planned and ongoing in order to accommodate increase of passenger traffic.

Kaunas International Airport is the second-busiest civil airport in Lithuania after Vilnius Airport and the fourth-busiest in the Baltic states. The airport is located in the central part of the country, 14 km northeast of the Kaunas city centre and 100 km west from the capital Vilnius.

5 https://www.vilnius-airport.lt/upload/uf/847/84734affbe7b998b33b583cfc650fb7e.pdf

Kaunas passenger traffic for year 2018 was about 1 million and is offering between 15 and 23 destinations accommodated by 2 low cost airlines (Ryanair and Wizzair) and 1 charter. No direct flights to other Baltic country destinations from / to this airport are offered. There is no passenger in transit or transfer in Kaunas airport.

Currently there is no direct connection by railway but only by bus.

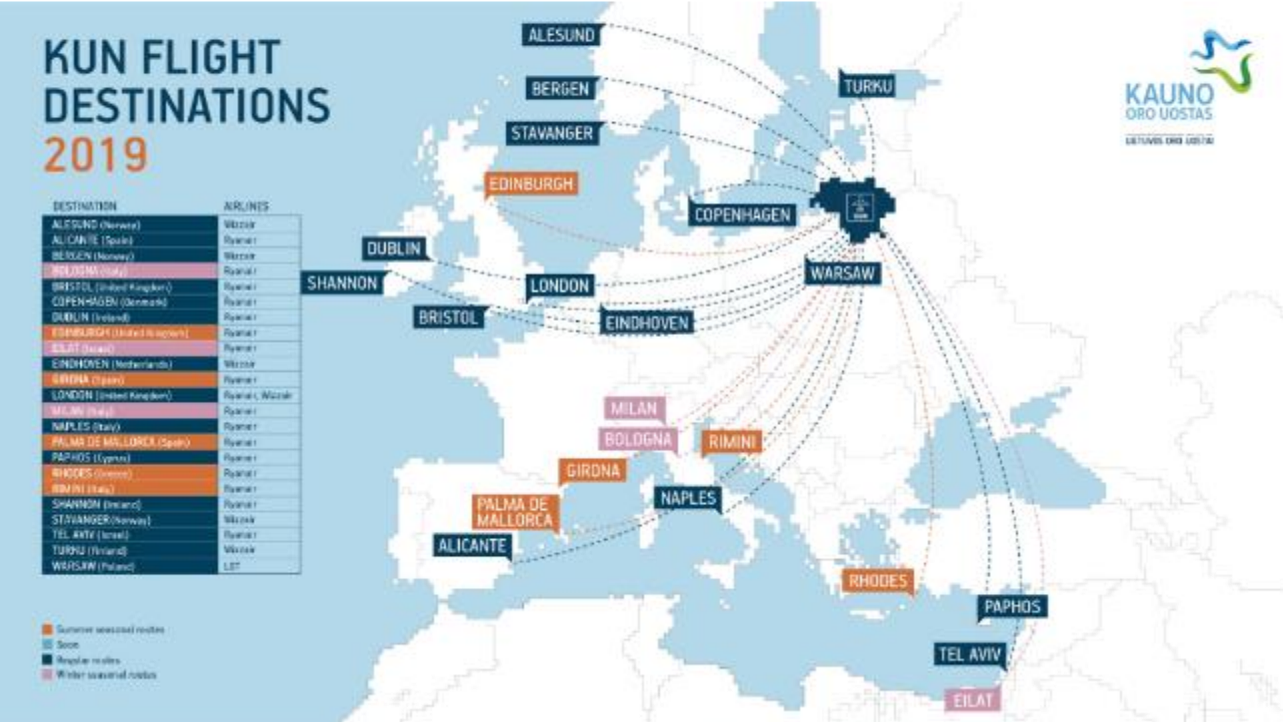


Illustration 12. Flight destination from Kaunas airport

Publicly announced by the Ministry of Transport and communications, there are different options regarding airport extension in Lithuania or construction of a new airport. It is currently a State decision to keep several options possible (new airport or system of Vilnius-Kaunas airports) in 2022 and to reserve lands for new airport (which could be opened in year 2034) while to extend capacities of Vilnius and Kaunas airports for needs of 10-15 years ahead.

The expansion concept for the airports is being coordinated with the construction of the European-gauge railway Rail Baltica (the airports and Lietuvos Geležinkeliai -Lithuanian Railways). It means that passenger stations are foreseen – nearby Airports (Vilnius central station and link to Vilnius airport; Kaunas Airport passenger station foreseen near-by airport location[6]). Future New airport is coordinated with Lithuanian railways and exact location of

[6] Agreed by Lithuanian railways, that RB station in the south of KUN airport does not make sense while airport terminal, apron, taxiways, etc. are located to North from the runway and there is no fast connection.

the future passenger station will be planned during planning stage of the Kaunas-Vilnius territory planning procedures, which are ongoing now.

Started last year, the reconstruction of Vilnius Airport is set to continue until 2022. It will include the expansion of the passenger terminal northwards, the expansion of the northern apron and also the construction of a new VIP terminal.

During the working meeting (11/06/2019), main issues raised by Vilnius airport representatives were:

- Given capacity issues at Vilnius and Kaunas, it is possible a new airport may be constructed between Vilnius and Kaunas;.
- There are also different airport extension projects, for Vilnius and Kaunas to be presented to the state strategic project committee and decision makers";
- Vilnius airport has currently a capacity to handle 800 to 900 luggage per hour (double capacity in 2022) with lot of manual activities. If the number of luggage provided by RB is significant, with some peaks, congestion of the sortation system could be an issue but RB will be ready only in 2026. It could be solved by the IT system with information notice;
- In general, longer time than 40 mn before the flight departure shall be considered;
- It is recommended to RB to assess if Home-airport integrated services (as Airportr) could be a more modern approach. It means that passenger and luggage check-in facilities will not have to be provided;
- Flight information could be provided on train-board;
- 50 % passenger check-in is performed at airport and completed by 50 % for drop-off luggage (which is in fact luggage check-in);
- Integration of an access, loading unloading place to accommodate RB luggage container is not a major issue but is shall be considered in the extension project;
- Kaunas airport is more dedicated for low-cost airline companies. It is not obvious that passengers will be attracted to pay more for rail-airport integrated services because they are mainly focusing on saving money.

Conclusion: there is also a need to keep informed Vilnius – Kaunas airport representatives about the last RB development and to have some coordination works regarding the development of terminal extensions to integrate rail-airport services.

Operational constraints with airport

Introducing rail-airport integrated service will have an effect on airport processes and luggage flows through the airport terminals. It shall be ensured that:

- The solution will not be in conflict with other existing operations. It means that it shall be considered that common rules, equipment are already existing in the airport and the rail-airport service shall be integrated in a smooth way with only minor modifications or only additional devices;
- The upstream or downstream logistics network to handle luggage shall be developed according to specifications (size of luggage, contents, etc.);
- The solution must comply with existing security regulations.

For airline: Currently GH companies are responsible for the check-in process including the luggage handling. Main requirements are:

- The rail-airport integrated solutions shall comply with all security regulations and shall ensure secure storage of luggage after check-in.
- It shall be clear agreements on liability issues according to the service level provided: after check-in, if the check-in is performed in a railway station, the airline is endorsing the responsibility even if the railway is in charge of transporting the luggage. If is only a drop-off service for the railway journey, the railway company is endorsing the responsibility.

For passengers: expectations of passengers are mainly result oriented:

- The luggage drop-off and check-in process (if any) needs to be clear, fast and transparent, the same for pick-up package (return trip);
- It must be clear which company to contact in case of problems and preferably only one single contact point whatever are the number of stakeholders involved;
- It is preferable if passengers would not have to make an additional journey for the luggage check-in or drop-off to the station. If not, it is preferable if passengers do not have to hand in the luggage to the railway desk too long before departure and not to receive it too long after arrival;
- The service should not be too costly for passengers

Potential extension of operation service(s) beyond Air-Rail:

In addition to the above design and operation implications, potential extension of services beyond air-rail aspects can also be considered. It has not been identified any relevant issue which either impair the implementation of rail-airport integrated service or makes them “obsolete” in the short term:

- Passenger check-in in station: most of airline passengers are performing on-line check-in by internet. So, the possibility to perform airline check-in in station will be less and less and issue. Nevertheless, luggage registration will still be required (so desk, IT connection, IATA code, etc.).
- Potential extension of services beyond rail-airport integrated services shall also be considered. Main principle is to include the last missing segment of passenger transport trip, from / to home from / to railway station. If generalized, it could have a limited impact mainly limited to the desk in RB stations which not be not be provided).

  As example, AirPortr is a London-based same-day luggage delivery service, transporting bags to and from London Heathrow, Gatwick and City airports, as well as homes, hotels and offices. The service helps passengers to make the most of their day in London bag-free, whether they have an early flight into the city and don't want to carry bags around before checking into a hotel or have a late flight and don't want to pay extra for storage. This technology is also implemented in Finland.

Illustration 13. AirPortr desk in a London airport

"AirPortr" services are summarized in the illustration below:

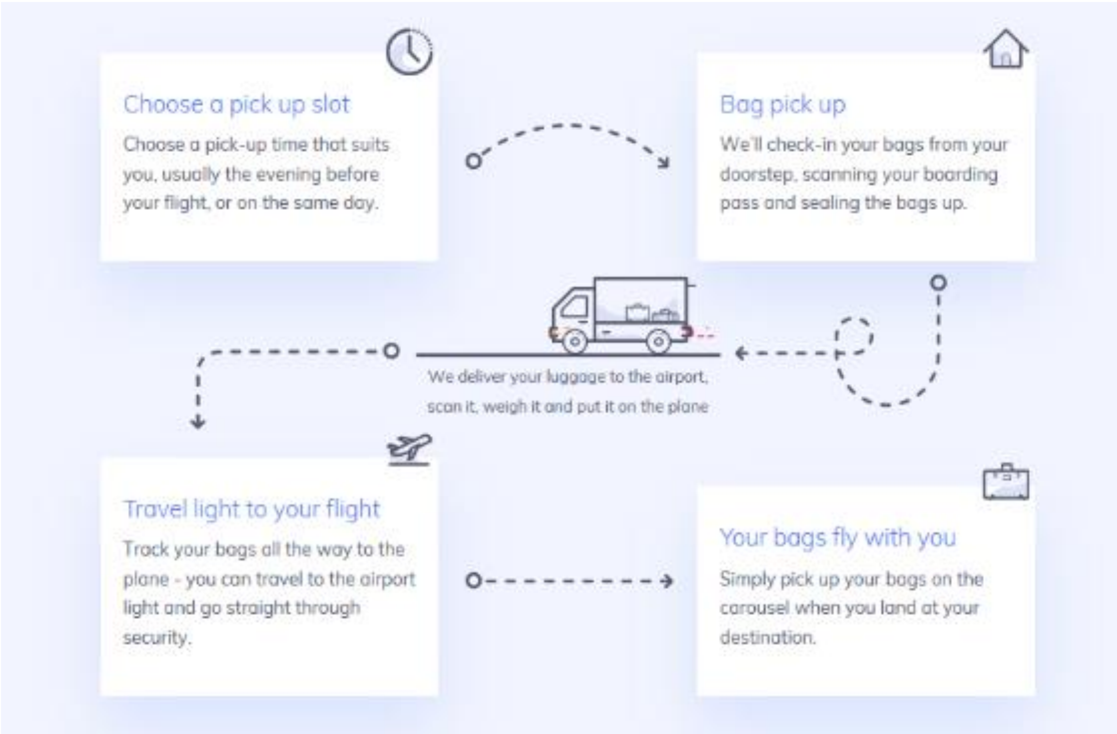


Illustration 14. AirPortr down(town luggage check-in service

Instead of to deliver luggage directly to the airport, the down-town check-in service could be offered between home to the railway station in complement of integrated services offered in the station.

Recently Airportr became interested in collaborating with a rail company when it was noticed the effect AirPortr company was having on air passengers' travel habits : almost 60% of passengers were switching from taxis to trains because of home check-in services, and this inspired the decision to create a "joined-up experience for the customer" with train network operators.

High-level description of services that can be offered by RB

For passengers, rail-flight combined ticket shall be offered for sale on general by RB (on desk, by internet). There is no direct "physical" design impact regarding stations, rolling stock, most of the issues being to establish partnership agreement between RB railway operator(s) and airline company and IT integration solutions.

To facilitate this IT integration, it is recommended **to register RB railway stations to get a "IATA code"**. IATA codes are three-letter codes that designate international and regional airports. his code has been extended to the stations, especially because of the code share flights between airlines and rail lines.

For luggage, rail-airport full integrated services are recommended to be targeted by RB, not limited only to railway express shuttle stations (as Riga airport) but also to other "regular" railway stations (as Tallinn, Pärnu, Riga, Panevėžys, Kaunas and Vilnius). Also, it shall be considered that the partial integrated services alternative is a “simplified” version the full integrated service not offering airline-check-in possibility.

Main recommendations for RB:

- For passengers, rail-flight combined ticket will be offered, in all RB railway stations, by internet; This is to be achieved by promoting integrated cooperation between airlines and rail operators.
- For luggage, rail-airport full integrated services will be offered by RB in Tallinn, Pärnu, Riga, Riga Airport, Panevėžys, Kaunas and Vilnius railway stations. These stations will also offer partial integrated services mainly for the return trips (airport to home).
- RB railway stations where rail-airport integrated services will be implemented (Tallinn, Pärnu, Riga, Riga Airport, Panevėžys, Kaunas and Vilnius) shall register and get a “IATA code”;
- For passenger, no additional journey to drop or to pick up luggage at the station, reasonable fares are recommended following Cost Benefit Analysis simulations to test price sensitivity.;
- With airlines and airports, clear liability agreement especially regarding security controls will be required.
- Rail-airport integrated services shall also be integrated in a smooth way with only minor modifications or only additional devices having an impact on airlines and airports.

WP 4.2 - Overview of typical implications for station infrastructure and operational requirements for such services

Overview of typical station infrastructure design issues

Despite that some specific and different constraints related to the check-in process and responsibility / security to transport "checked-in" luggage (please refer to "Overview of typical security arrangement chapter), it is assessed by the Consultant that the main core of "design solutions" and specific requirement are the same for both rail-airport integrated service alternatives, partial and full ones.

So, for the full integrated rail-airport services to be provided by RB covering both directions of the railway-airline combined trips are:

Nbr	Transport chain segment / action
A1 - both directions	Drop-off, pick up, registration or check-in of luggage at a registration desk in railway station - Drop-off and registration of luggage only
A2 - both directions	Storage of luggage in railway station, storage room, protection against loss, theft, vandalism and un-authorized access
A3 - both directions	Transport of luggage to the railway station platform from / to the storage room. Protection against loss, theft, vandalism and un-authorized access
A4 - both directions	Loading / unloading luggage on / from trains board from / to platform
A5 - both directions	Transport of luggage from / to railway station to / from airport, same train as the passenger preferably (to prevent to have dedicated additional luggage management operation (from / to home to / from railway station). Protection against loss, theft, vandalism and un-authorized access
A6 - both directions	Loading / unloading luggage on / from trains board from / to platform
A7-Dep. (station to airport only)	Transport of luggage from railway station platform to the Airport's luggage handling system (BHS) or storage room eventually
A7-Arr. (airport to station only)	Customs controls, transport of luggage from the Airport's luggage handling system (BHS) to the storage room in airport railway station (buffer zone). The "buffer zone" is required to perform baggage sorting according to passenger train destinations
A8-Arr. (airport to station only)	Storage of luggage in airport railway station.
A9- Arr. (airport to station only)	Transport of luggage from the storage room of airport-railway station to platform, followed by segments A6 – A5—A4- A3 – A2 – A1

Table 5. **Overview of typical implication for stations**

Overview of typical station operation issues

<u>General issues:</u>

For an off-airport luggage management and check-in facility to be successful, it is critical that operations run smoothly, in a reliable, safe way and, as explain in the previous chapters, in a synchronized interdependent way. It is essential that the percentage of mishandled luggage coming from the railway source does not exceed the percentage of mishandled bags at the airport check-in, otherwise customers will be reluctant to use the facility and rail-airport integrated services solution will be considered as being risky. Also, it is important to prevent the "No-show" of passengers at boarding gates leading to unload luggage from the plane.

Besides the equipment, it is of vital importance that IT systems function as intended. The IT system needs to be sophisticated enough to handle off-airport services in a manner that does not require significant change to airport processes or systems.

Furthermore, timing is an important operational issue. Using rail-airport integrated services should preferably decrease, but definitely not increase the amount of time passengers have to spend at the airport before departure, because dwell-time at the airport already set up at "2 hours before" is already considered to be too long by passengers. This objective of time reduction is also subjective according to passenger categories (business, leisure) and from the point of view of the different stakeholders. There is an obvious business interest from airport to ensure retail activities and longer is the passenger staying (in a reasonable way captive inside the terminal waiting for the plan, more he is supposed to enjoy duty-free shops.

<u>Allocation of responsibilities between Rail Infrastructure Manager and Railway Undertaking(s):</u>

One of the key issues is to identify which entity is owning, managing and maintaining the different physical components required for the implementation of rail-airport integrated services.

At the level of EU, there are four different types of entities that are responsible for the management of passenger stations. These include the infrastructure manager (IM), integrated incumbent railway undertaking (RU), other RUs, and other third parties. For the majority of EU countries - with the exception[7] of Belgium, France and Sweden – the IM is responsible for the management of passenger stations. The same structure is supposed to be applied for RB. It is supposed that the IM will offer rail-airport integrated services in stations to Railway Undertaking(s) who will pay for these services. The European Directive 2012/34 sets out charging principles to be implemented by the Member States including additional and ancillary services.

Despite of this, it shall be clarified also the share of responsibility between the IM and RU(s). It is supposed at this stage that, as long as luggage is in the station, the IM is responsible and once on train-board the RU is committed.

Some components can be considered either part of IM or RU(s) responsibilities as the containers or trolley cages which will be either on train board or in station.

7 https://www.irg-rail.eu › download › IRG-Rail169

Luggage containers or trolley-cages will be uniform in terms of functionalities, size, and locking systems enabling them to be accommodated by any handling system in station and any RU trainset. They will be owned and maintained by the IM.

To simplify the container operation, sortation of luggage, handling in the different trainsets of a single RU or several RUs, container fleet will be considered to be a common pool of IM.

Another solution could be to have an existing ground handling Company such as Swissport, Menzies, Dnata, Havas involved for the managing aspects leading limiting by this way the number of actors involved in handling activities.

Passenger and luggage trip synchronization issues, impact on station operation:

Also, if several passenger “logistics” operations are required (first drop-off with or without check-in the day before departure in the station, going to the station again the flight departure day or same routine to pick-up the luggage for a return trip) or handling the luggage at the railway airport desk only for the purpose of check-in will influence the passenger perception that this could be more complex than simply carrying luggage with him.

To be considered as “full integrated services”, railway, airport and airline processes are interdependently linked and there are specific constraints related to “passenger and luggage trip synchronization chain” more significant for full integrated service alternative than for the partial integrated service one.

In general, airline companies are carrying luggage in the same flight as passenger owner. If there is “No-show” passenger at boarding desk, the luggage is unloaded. It is commonly understood that luggage shall travel in the same flight to prevent or limit the risk of terrorism with unattended luggage (in simple words: if there is a crash due to terrorism action, bombs, etc. the terrorist will be in the plane also and supporting same risks as other passengers).

Despite of that, it is not mandatory by International Regulations (Regulation (EC) No 261/2004 could regulate this aspect) but a common and security practice implemented by airport / airline but also for logistic and responsibility reasons if the luggage is not “following” the same trip schedule of the passenger:

- If the luggage is travelling by an earlier flight than the passenger, it shall be collected at arrival, stored, retrieved (on time) to be loaded in the same plane as the passenger;
- If the luggage is travelling by a later flight than the passenger, it shall be collected at arrival, stored, retrieved (on time) to be loaded in a plane, stored again after landing waiting to be picked-up by the passenger who shall go again to the airport for this purpose.

So, the check-in process imposed by airport and airlines aims to limit storage constraints-and other logistic operations, main idea is that the luggage shall travel with the passenger owner with the following main rule: check-in of the passenger first and if the passenger is checked-in, check-in of luggage is possible.

Check-in desks of airlines in airport are usually open 2 hours (minimum) and closed 40mn before the flight departure offering a “window to proceed”, allowing the loading of luggage in the plane. The 2 hours rule is guided by the time it takes for checked luggage to be loaded into the plane from the counter and how long it takes a passenger to get from the desk to the gate. Passengers are most of the time choosing to check-in by internet so this operational window is now more and more dedicated for passenger luggage check-in only to a check-in desk (called now in airport “luggage drop-off desk”). Typically, as example[8]:

Illustration 15. Typical check-in process in airport (Source www.bangkokair.com/pages/view/online-check-in)

Regarding operation of stations, trip synchronization issues shall also be considered. It could have some risk of “No-show” passenger on train board for any reason. In a practical way main risk is to have a luggage sent to the airport, loaded on aircraft board.

Problem will be identified at the time when the passenger is supposed to board on the aircraft (No-show on gate) with the obligation to unload the luggage from the aircraft. Despite of this, it is also possible that a passenger may

8 https://www.bangkokair.com/pages/view/online-check-in

decide at the last minute to travel by another way than by train, the luggage being already handled by the station and despite having already purchased and train ticket and have already proceed to airline check-in at station. As far as he will reach the airline gate on time, it is not disrupting the global trip process.

In some way, using IT system, it looks possible to associate the luggage trip with the effective presence of the passenger on the same train board and avoid aircraft boarding, the luggage being kept at the arrival railway airport station if the passenger is not on train board.

Security and Regulatory – Operation related issues:

Main issue for security issues is to define if the railway trip should be considered or not as a “flight on rail”, RB having the same duties as an airline, railway station equipped with the same security check equipment as in airport (after check-in desk). In this case, the airport becomes only a “transit point” (as between 2 flights) and the railway station the entrance or exit point of the rail-airport integrated trip. It becomes “the worst case” for RB and security checks shall be implemented in railway stations (X-Ray, explosive, etc.) and luggage following a “transport chain integrity” between the station and airport including storage in trains. In this case, station operation will be significantly impacted with some “security zones”, authorization access, surveillance, etc.

Nevertheless, for RB, it has not been identified any specific reason (or benefit) or relevant existing example to push for that or to be obliged to introduce such complex high-level integration. Moreover, it has been collected from airports a general opinion that security checks, even if performed in the upstream part of the transport trip by RB, will still be performed again within the airport, under the responsibility of the airport. Main reason is that the railway “security chain integrity” is complex, with more stakeholders involved, will introduce more security risks, and is considered a priori and ultimately to be “non-reliable”.

More specifically, station operation will be slightly impacted with the obligation to have luggage stored and transferred from / to train board in safe way with protection measures implemented to prevent any intrusion of objects, loss of luggage, deterioration, etc.

Customs control issues:

According to IATA rules if an airport (in RB case a railway station) is not equipped for air traffic with third countries, control will be done at the arrival airport of the combined air-rail trip. Main recommendation is to consider that the RB railway station will and should not equipped for air traffic with third countries, so customs controls shall be performed at the airport. So, no specific impact on station operation has been identified with the need, for instance, to have "custom clearance room" of specific device to accommodate custom controls.

Closely related to security issues are other international or national regulatory issues with respect to luggage as example for prohibited products, drug or customs aspects because, in some countries, suspects can only be caught "red-handed" according to the customs law.

Passenger – luggage transfer interferences:

When luggage is registered and stored inside the storage room of the station, no possible interference is identified. The storage room will be locked with limited access.

Nevertheless, transfer to the station platform could generate some interference if the transit of luggage transported by the container tug handling device (please refer to WP 4.6) is crossing the natural path of passengers going from the main building of the station to platforms.

Main recommendations are:

- During the station design development, passenger paths shall be identified, dedicated luggage transfer pathways shall not cross passenger ones;
- Specific devices shall be provided as luggage elevator (for services only) if platforms are not at the same level as the storage room;
- Access tunnels, in case it will be required shall also be reserved for services only;
- During the time of loading / unloading luggage into / from trains, the loading area of the platform shall have temporary limited access. Main easy solution is to set-up some removable barriers.

Finally, it is also recommended to include during the design, the transfer of luggage inside the global simulation of passenger dynamics usually developed using specific software as SimWalk[9] transport.

[9] https://simwalk.com/simwalk_transport/index.html

WP 4.3 - Overview of typical requirements on rolling stock design, operation and maintenance

Overview of typical requirements on rolling stock design

Main functional requirement for the rolling stock, is to provide luggage compartment(s) on train board able to accommodate containers or trolley cages.

Main issue is also the location of the luggage compartment(s) in the train composition and several requirements shall be considered together:

1) The loading / unloading of the luggage container shall not interfere as far as possible with passenger flows on station platform. So, the most obvious solution, to fulfill this requirement, is to have the luggage compartment located at the end of the trainset, behind the driver cab and not in the middle part of trainset.

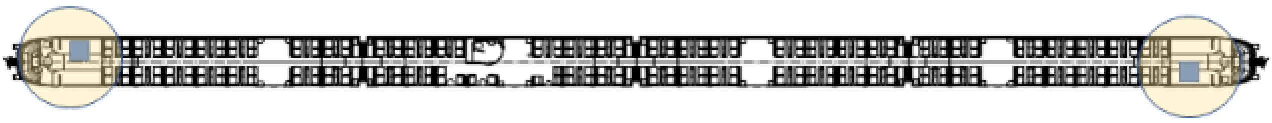
2) It would be preferred having the luggage compartment always located on the same area and side of the platform as for example, behind the driver cab at the front end of the trainset. But due to the phenomena of "railway network triangle effect" it cannot be ensured that the trainset will reach the station always oriented on the way (Cab 1 in front for the train direction, as example). So, when reaching the station, the luggage compartment can either be at the front end but also at the rear end of the trainset and therefore the loading / unloading place cannot be guaranteed to be always the same side.

3) Platform can be either on the right or left side of the trainset (lateral platform or central platform). So according to each station layout loading or unloading of the luggage container can be either on the right or left side of the trainset.

4) Finally, main solution is to have 2 compartments (or places) for the storage of 2 luggage containers (one in each compartment), each compartment being located at each end of the trainset and behind each driver cab. Access from platform shall be possible on both sides of the trainset.

5) For safety and comfort reasons, the luggage compartment(s) with restricted access, shall not be an obstacle for passenger circulation along the trainset (from one car to another) and also shall be an obstacle for the driver to move from the driving cab to the passenger area.

As a tentative, the layout could be the following:



Despite of having been loaded with a platform on the right side of the trainset, the luggage container can be unloaded on the left side.

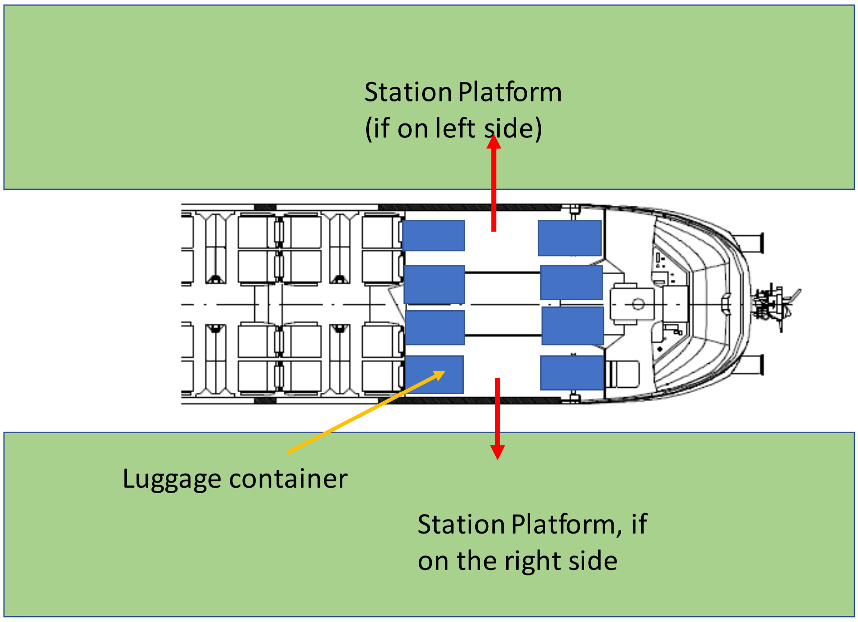


Illustration 16. Location of luggage compartment on train board (tentative)

Requirements of TSI regarding rolling stock shall also be taken into account to assess also if free passage shall be provided from / to the driver cab to the rear part of the trainset:

> 4.2.9.1.2.1 - *The driver's cab shall be accessible from both sides of the train from 200 mm below top of rail. (2) It is permissible for this access to be either directly from the exterior, using a cab external door, or through the area at the rear of the cab. In the latter case, requirements defined in this clause shall apply to the external accesses used for access to the cab on either side of the vehicle.*
>
> "4.2.9.1.2.2 - *In an emergency situation, evacuation of the train crew from the driver's cab and access to the interior of the cab by the rescue services shall be possible on both sides of the cab by using one of the following emergency exit means: cab external doors (access directly from the exterior, as defined in clause 4.2.9.1.2.1 above) or side windows or emergency hatches."*

So, it is understood that there is no mandatory obligation to offer an emergency passage to the train driver from the driving cab to the rear part of the trainset via the luggage compartment.

Uniform Luggage Compartment Design:

As specified in the chapter related to station operation, luggage containers will be uniform in terms functionalities, size, locking systems to be accommodated by any station with same handling devices and be owned and maintained by the IM.

It will have some impact regarding the design of luggage compartment design with specific features to accommodate uniformized size and shape container (as it is for aircraft) as floor lockers, rail guides.

Overview of typical requirements on rolling stock operation and maintenance

Rail-airport integrated services implementation will have a limited impact on rolling stock operation and maintenance. Only and all fleet long-distance passenger trains EMUs will offer such luggage compartment on board, reversibility of trains will be ensured with a compartment on each end side, so it will not have specific needs to manage in a specific way (orientation of trainset) these trains.

Handling operation from / to station platforms to / from train board will be assumed by the IM as well as maintenance activities (container tug handling device).

Luggage compartments will be maintained by the RU (or RUs) and the fleet of luggage containers by the IM.

Analysis of impact of CAPEX, OPEX and LCC.

Though the rail-airport integrated services can be beneficial, there are also significant costs to such an introduction, balancing the costs and the benefits for and between each of the stakeholders involved is a complex exercise. Most difficulties arise because of the inability to fully capture the benefits, the inability to clearly demonstrate exactly which stakeholder incurs which costs and receives what extra revenue up front (and when) and because the benefits are generated evenly over the life of the project while most costs are incurred before the project has even started.

The following CAPEX and OPEX are provided in order to identify main input data for the development of a specific CBA model.

CAPEX:

Rolling stock impact:

In the financial model it shall be considered that luggage compartments allocated in each trainset, will in some way not be available for the transport of passengers. Considering the low volume of luggage to be transported in each trainset, it should be considered maximum and in total the equivalence of 25% of one passenger car dedicated for this in each trainset. Each HST trainset being composed by 8 cars, it could be considered that about and no more 3 % of the total cost of each trainset could be allocated for rail-airport integrated services purpose.

Rail-airport station impact:

Compared to the initial cost of a new station, additional investments are negligible, estimated to be in the range of Euro 0,5 million for each station.

It is supposed that a fleet of about 100 containers will be required, each container having a unit price of Euro 10 000.

OPEX:

The most important additional costs are those related to loading / unloading equipment and storage costs. The staffing costs are considered less important because it is considered that activities are simply transferred from airport to railway stations.

In station, it is estimated that minimum 4 or 5 people shall be required in e (2 shifts per day):

- At registration desk: 2 persons;
- Storage – sortation of luggage – handling: 2 persons.

There are no specific operation costs identified on train-board once the container will be locked inside the luggage compartment by the staff of IM.

The same value of 3% shall be considered to calculate the specific energy consumption required, costs of energy regarding moving luggage compartment on rail. According to the Consultant calculations about 0,11 kWh-km trainset shall be considered for luggage transport.

LCC:

Among the rolling stock components, maintenance of containers or trolley cages are surely those which will have the shortest life cycle. It is estimated that the fleet of container shall be replaced after 15 years maximum.

Costs being negligible (maxim Euro 10 000 each container), it is far to have a major impact on the global LCC model.

WP 4.4 - Overview of typical security arrangements

Compared to "logistics" issues, security issues are the more important influencing factor in the different solutions already proposed and addressed in the above examples and alternatives. It could lead to prefer some limited services of partial integrated service or off check-in followed by additional drop-off at airport, etc. (as with the mixed solution of Deutsche Bahn Railway / Lufthansa). Security issues have become increasingly important in air transportation, mainly after the terrorist attacks of 2001 in the USA, for example as significantly impaired or delayed the implementation of rail-airport integrated solutions. Check-in of luggage is an important security issue and more especially in railway remote check-in facilities. Normally luggage shall be thoroughly screened in the airport's luggage handling system (BHS) and, once checked in, needs to be secured and monitored, in order to prevent unauthorized access to the luggage. During the railway trip (and also by vans) it means that luggage shall be protected in a similar way to prevent unauthorized access.

Security issues need to be considered by each of the different stakeholders involved in the off-airport check-in process. Setting common standards and adapting to ever changing security regulations are challenging aspects.

Passengers

For passengers this study has not identified specific security issues related to have a rail segment transport integrated within the trip. The main security constraints are that check-in of luggage can only be performed once the passenger is checked-in himself first. As said before, passenger check-in is more and more performed by on-line airline check-in system.

Responsibilities

According to Regulation (EC) No 889/2002 of the European Parliament and of the Council of 13 May 2002 amending Council Regulation (EC) No 2027/97 on air carrier liability in the event of accidents, the airline is responsible in case of delays, damage, loss, destruction of luggage with some amount regarding liability.

The Montreal convention attempts to re-establish uniformity and predictability of rules relating to the international carriage of passengers, baggage and cargo.

For RB operators, same rules should apply: the responsibility of the railway operator will be engaged as soon as it will proceed to the luggage registration (with or without airline check-in included).

Luggage control (before check-in)

Despite that the number, size and weight of luggage are not imposed for security reasons, airlines set the rules for how many bags it can be checked in and for possible related charges. Rules are different between carry-on hand baggage and luggage checked in luggage. IATA has guidelines for baggage but the number and weight of baggage allowed free of charge can vary by airline, frequent flyer status, routing and fare.

The maximum weight for one bag is 32KG in the EU and the US. Some airlines impose lower limits. The "piece concept" is generally in use on flights within, to and from Canada and the United States. This concept defines the number of bags entitled by the passenger's ticket. Where the "piece concept" applies, generally, two pieces of checked baggage are allowed per passenger, each piece weighing a maximum of 32 kilos and measuring no more than 158 cm when adding dimensions: height + width + length.

Compliance with IATA resolutions:

Despite that all resolutions are not security related or only partially related, IATA has issued a set of Resolution related to luggage:

- Resolution 709 - Baggage Transfer Message (BTM)
- Resolution 739 - Baggage Security Control
- Resolution 740 - Form of Interline Baggage Tag
- Resolution 741 - Passenger Name and Address Label
- Resolution 743 - Found and Unclaimed Checked Baggage
- Resolution 743a - Forwarding Mishandled Baggage
- Resolution 743b - Baggage Identification Chart
- Resolution 743c - On-hand Baggage Summary Tag
- Resolution 744 - Local Baggage Committees
- Resolution 745 - Dangerous Goods in Passengers' Baggage
- Resolution 745a - Acceptance of Firearms and Other Weapons and Small Caliber Ammunition
- Resolution 745b - Acceptance of Power-Driven Wheelchairs or Other Battery Powered Mobility Aids as Checked Baggage
- Resolution 746 - Pooling of Baggage
- Resolution 751 - Use of the 10 Digit License Plate

- Resolution 752 - Electronic Baggage Claim Receipt
- Resolution 753 - Baggage Tracking
- Resolution 754 - Profiles of interline baggage claims and proof of fault for baggage prorates
- Resolution 763 - Location Identifiers
- Resolution 765 - Interline Connecting Time Intervals - Passenger and Checked Baggage
- Resolution 769 - Baggage Tag Issuer Codes (BTIC)
- Resolution 780 - Form of Interline Traffic Agreement - Passenger

Completed by "The annual Passenger Services Conference Resolutions Manual"[10] which contains all the Resolutions and Recommended Practices (RP) that IATA publishes for baggage handling, processes and baggage prorates.

For full rail-airport integrated services, as the passenger will proceed to check in luggage in railway stations, the above Resolutions shall be implemented in railway stations in order to prevent any problem at the airport (rejection of the luggage).

Security checks

Security checks are covered by IATA resolution n° 739. In the transit life of a passenger's luggage, several states can be identified:

- In some airport (but not all), there is X-ray control at the entrance of the airport terminal
- First controls: size, weight, self-control by the passenger that no forbidden products or objects are in the luggage
- The registration / identification / airline tag production

Once these steps passed (it can be said, once the luggage is transferred to the BHS conveyor system), lot of security checks are performed by the airport (and usually unknown by the passenger) as X-ray control, explosive, drugs checks…

Based on the European Regulation 300/2008 and Annex 17 to the Chicago convention of 1944 on safety and security for civil aviation, the following requirements with respect to hold luggage can be identified (International Civil Aviation Organization, 2006; European Parliament and Council of the European Union, 2008):

- Luggage needs to be protected from interference by unauthorized persons once it has undergone the security checks or it has been accepted into the care of the airline, whichever is earlier.

10 https://www.iata.org/whatwedo/ops-infra/baggage/Pages/standards.aspx

- Luggage can only be loaded onto an aircraft if it is identified as accompanied, meaning the passengers needs to be on board of the same aircraft, or when it is identified as unaccompanied and has undergone additional security checks.
- According to the rules of most air transportation authorities, such as the U.S. Federal Aviation Administration and European Union's Joint Aviation Authorities, should passengers flying internationally with checked baggage fail to arrive at the departure gate before the flight is closed, that person's baggage must be retrieved from the aircraft hold before the flight is permitted to take off. Since it is checked-in and tag registered, luggage is inaccessible to the passenger during the flight or transport, as opposed to carry-on baggage.

Tracking Luggage

International Air Transport Association (IATA) Resolution 753 came into effect in June 2018[11]. It says that 'IATA members shall maintain an accurate inventory of baggage by monitoring the acquisition and delivery of baggage'.

The aim is to reduce the number of lost or delayed pieces of baggage by keeping track of it at every stage of its journey through the use of intelligent tracking capabilities. This leads to a better customer experience and at the same time reduce the costs involved in tracing, retrieving and delivering missing or delayed bags. It will also reduce baggage fraud.

When a passenger checks in for a flight, a bag source message (BSM) is generated, which includes the date, flight number, destination, registration number and a unique barcode – this is typically referred to as an "IATA Licence plate". The barcode on the tag is checked against a computer database of departing flights and set for delivery to the correct terminal and gate.

Following the security check, the baggage moves through the airport system on a series of conveyor belts or tray (tote) conveyors until it reaches the correct loading bay. Prior to being loaded onto the plane, the unique bar code is scanned or otherwise registered to make sure that the bag has reached the correct flight before being sent on its way.

To comply with IATA Resolution 753, airports must monitor the acquisition and delivery of bags at four specified events:

- Passenger handover to airline;
- Loading to the aircraft;
- Deliver to the transfer area;

11 Baggage Tracking IATA Resolution 753/A4A Resolution 30.53 Implementation Guide

- Return to the passenger.

And airlines need to share the tracking information with interline journey partners as needed

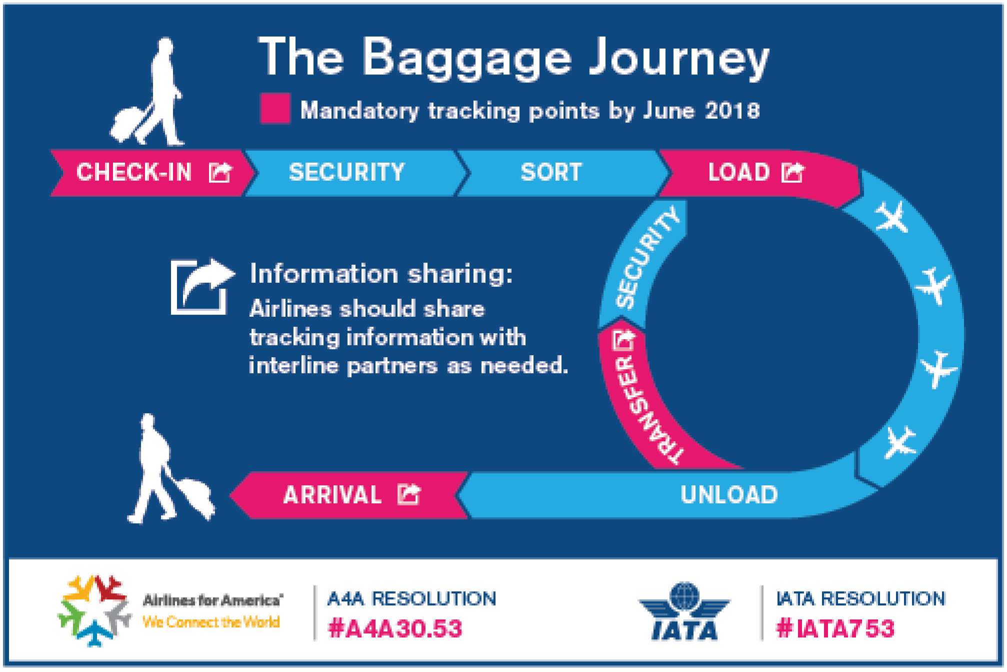


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Illustration 17. IATA resolution n°753, tracking points (Source IATA)

This part of the IATA compliance, which would allow interoperability between airlines, is being looked after by the Passenger and Airport Data Interchange Standards (PADIS) Board. PADIS is governed by Passenger Services Conference Resolution 783 to develop and maintain Electronic Data Interchange and XML message standards for passenger travel and airport-related passenger service activities.

RB operators shall at least ensure, if luggage check-in is achieved in station, to follow the same rules as in airport. There are several options, which are already widely used airlines and airports but rarely seen at the arrivals of luggage:

- Manual scanning – can be done without an automated baggage handling system but requires extensive staff resources and handheld terminals. Every item of baggage must be handled manually and the process can be slow.
- Laser Scanning of Bag Tag – this is a widely used Automatic Tag Reading (ATR) technology found across most automated baggage handling systems, although it cannot guarantee 100% readability.

- The Automatic Tag Reading technology can be complemented or replaced by cameras. This type of Optical Character Recognition (OCR) technology and Video Coding System (VCS) are widely used in the parcel industry and OCR and VCS software can help to identify the flight numbers and airport codes.
- One of the most modern solution currently progressively implement is the use of RFID technology using radio-frequency identification technology to deliver a flexible, extendable baggage tracking capability that integrates with existing systems. RFID uses electromagnetic fields to automatically identify and track objects using tags containing electronically stored information. The solution uses RFID chips embedded in bag tags with readers and antennae positioned at critical points along the baggage journey. The antennae read the information embedded in the RFID chips and pass it on to the baggage management system. Bags are then processed according to the business rules of the airline.

Customs controls

According to international Regulation, several cases[12] are considered for customs controls, mainly if the passenger is travelling inside EU only or if the passenger is coming from a country outside the EU. There are also specific rules regarding if the passenger has airport transit(s) in different airport(s) of the EU, staying in the same plane or not and a differentiation is done between "hand baggage" and "other baggage". Main rules are the following:

- For travelling inside the EU, the luggage is not subject to any customs control at airport arrival (luggage with green edges label);
- For passenger coming from outside the EU, the registered luggage (luggage with "normal" label) and hand baggage are liable to be checked by customs at the EU airport, the last one in case of airport transit. If the last airport is not equipped for air traffic with third countries, control is done at the first one.

In large airports, it is not always possible to separate passengers flows according to the point of departure of their travel, whether they started their journey in an EU or in a non-EU airport. It can therefore happen that passenger of both categories mix in airports common areas. However, luggage which come from a non-EU airport can be subject to controls while luggage registered in an EU airport do not.

For RB it is more than likely that code-share agreements will be set-up with airline companies, mainly to facilitate luggage registration following IATA Resolution n°753 and tracking. Also, it is more than likely that railway stations will have a IATA identification code for the same reasons. It could be therefore considered that the last railway station of the air-trip shall endorsed the same duties as the last arrival airport of a pure airline trip combining transit in another airport inside EU. So, in this case, for passenger coming from outside the EU, the registered luggage (luggage with "normal" label) and hand baggage are liable to be checked by customs at the last railway station.

12 https://ec.europa.eu/taxation_customs/business/customs-controls/travelling-air_en

Despite of this, main recommendation is to consider that the railway station will and should not equipped for air traffic with third countries, so customs controls shall be performed at the airport.

Typical security arrangements for RB

Taking as assumption that RB will not be obliged an have not any interest to set up a “security integrity transport chain” (please refer to security consideration chapter) and to implement IATA Resolution n°739, for RB operators, mainly the typical security arrangement will be quite similar as the above requirements but limited to the first steps and tracking aspects:

X-ray at entrance of stations (or CT mm-wave scanners), not required, it is mainly for the security inside the airport terminal. Eventually X-ray may be installed for the same reasons (security inside the station and trains) but it shall apply for all luggage even not rail-airport integrated.

For partial rail-airport integrated services, RB’ rules shall be defined regarding security aspects (labelling, size, authorized product, weight, etc.) but Airport / airline security rule respect less sensitive as the passenger will proceed himself to airline check in.

For full rail-airport integrated services, Typical security arrangements for RB will be limited mainly to the implementation of some IATA Resolutions excluding IATA Resolution n°739:

- Labelling, identification (IATA resolutions n° 741, 743, 740 and 769);
- Contents control (IATA Resolutions n°745), contents checks (same as in airport at the check-in desk, where passenger is required to confirm he has packed the luggage himself and is not carrying forbidden products and objects),
- Weight, size checks, number according to each airline rules
- Registration / check-in with deliverance of the airline registration tag (Resolution n°740);
- Tracking (Resolution n°753) by manual scanner or other solutions as RFDI (when loaded inside the container, when delivered at last railway station).

WP 4.5 - Brief overview of any implications for air-rail passenger services of the Graz Declaration

Graz Declaration

The Graz Declaration comes at a time when several initiatives – either at EU or global level – are being carried out tackling climate change-related issues and the sector which is most dangerously contributing to it: namely the transport sector. In this regard, a landmark step had been taken with the Paris Agreement ("COP21"), which entered into force in November 2016 – much earlier than predicted.

Against this backdrop, the role of rail in driving the actions enshrined in the Graz Declaration, notably in relation to transport de-carbonisation's policies, assumes a crucial relevance

Accordingly, a clear objective of the rail sector's research and innovation commitments is the decreasing of energy consumption in all railway applications, a key factor in order to keep rail the most environmentally friendly transport mode.

For RB rail-airport integrated services, in line with the Graz Declaration, the efficiency and attractiveness of Rail will be increased by:

- continuing to implement the Single European Railway Area, with improved interoperability, especially by removing barriers at borders and putting in place consistent operating rules;
- facilitate cross-border and passenger services that are of high enough quality using European funding tools;
- strengthen digitalization and automation in rail;
- increase multimodality and connections with other modes of transport (trains with planes, etc.).

Despite the fact that environmental benefits cannot be assessed and quantifiable without a specific and dedicated study (similar as an environmental impact assessment), it can be identified at least some qualitative positive impact:

- Attractiveness of the rail transport system. More passenger will be attracted if rail-airport integrated services are proposed. By this way, it is supposed that it will be transport modal transfer from road (buses, private cars) to trains, trains being the most environmentally friendly transport mode.
- Optimization regarding luggage handling process. In general, "handling" of luggage requires energy (even if it is only the passenger's own energy). The fact to gather luggage and to have only one common handling operation (the container) can be considered as some form of optimization.

The only negative aspects could be that, if the rail-airport integrated service once implemented is not a success, is will be considered a waste of money but also some waste of energy to carry empty luggage compartment on train board (instead of passengers). Nevertheless, as main recommendation, luggage compartment shall offer the possibility to be converted for the transport of passenger not involving major modification in the trainset structure.

Environmental impact, brief assessment

In general it could be considered for the model green-house impact regarding energy consumption (about 0,11 kWh / km trainset), whatever is the luggage compartment is empty or loaded the gross weight of the car being considered (weight of luggage is negligible compared to the empty weight of luggage compartment).

As usual, this value shall be converted in CO^2 emission of primary energy of RB energy supply and could be compared to green-house emission if similar quantity of luggage is transported by vans or private cars.

This exercise remains very theoretical: it cannot be considered that RB passengers going to airport but not using rail-airport services will have their luggage by another mean of transports (accompanied luggage).

There may also be an argument that the space allocated to luggage compartment is not available for passengers (so a passenger loss or reduction of passenger capacity).

Considering the demand forecasts, average load of passenger being in the range of 35 %, no negative impact could be considered but rather some optimization of the trainset capacity use.

WP 4.6 - Description of luggage transfer options

Recommendations for station - airport transfer mechanisms

The analysis of traffic forecasts of RB passengers who may be interested by rail-airport integrated services shows some uncertainties regarding the success of these services and also different level of passenger volumes according to the stations, trip Origin – Destination, number of passengers per train and time horizon (please refer to Market analysis presented in Annex).

So, the main achievable and realistic objective of typical station infrastructure design recommendation is limited to the identification of the components to be included and space to be “reserved” in stations, main design functionalities, constraints and conceptual requirement, to be included in RB design guide and to be developed further in terms of “technical solutions” by the station designer and rolling stock supplier.

Considering the transport chain segments targeted for RB, the following design provisions to be considered by RB are:

Nbr	Transport chain segment / action	Component required
A1 - both directions	Drop-off, pick up, registration of luggage at a registration desk in railway station - Drop-off and registration of luggage only	Provision for check-in registration desk
A2 - both directions	Storage of luggage in railway station, storage room, protection against loss, theft, vandalism and un-authorized access	Provision for storage room
A3 - both directions	Transport of luggage to the railway station platform from / to the storage room. Protection against loss, theft, vandalism and un-authorized access	Provision for carrying device, platform design.
A4 - both directions	Loading / unloading luggage on / from trains board from / to platform	Provision for handling device, platform design, rolling stock design.
A5 - both directions	Transport of luggage from / to railway station to / from airport, same train as the passenger preferably (to prevent to have dedicated additional luggage management operation (from / to home to / from railway station). Protection against loss, theft, vandalism and un-authorized access	Provision for rolling stock design.
A6 - both directions	Loading / unloading luggage on / from trains board from / to platform	Provision for handling device, platform design, rolling stock design.
A7-Dep. (station to airport only)	Transport of luggage from railway station platform to the Airport’s luggage handling system (BHS) or storage room eventually	Provision for carrying device, platform design.
A7-Arr. (airport to station only)	Transport of luggage from the Airport’s luggage handling system (BHS) to the storage room in airport railway station (buffer zone). The “buffer zone” is required to perform	

Nbr	Transport chain segment / action	Component required
	baggage sortation according to passenger train destinations	
A8-Arr. (airport to station only)	Storage of luggage in airport railway station.	Provision for a storage room
A9- Arr. (airport to station only)	Transport of luggage from the storage room of airport-railway station to platform, followed by transport segments A6 – A5—A4- A3 – A2 – A1	Provision for carrying device, platform design.

Table 6. **Provision to be considered by RB to fit with the rail-airport full integrated services alternative**

Check-in / registration desk(s) in railway stations

Related to A1 transport segments.

Functional requirements:

Desks in railway stations shall be suitable for the following functions:

- Drop-off luggage (partial integration service);
- Registration of luggage (for railways needs only for partial integrated services) or and luggage check-in for full integrated services (printing airline tag following IATA Resolution n°740);
- Control of luggage (before check-in, size, weight, number, products…),
- Pick-up luggage (end of the trip);
- Airline check-in of passenger;
- Optionally X-tray control device (for the purpose of railway / train security needs only, security control for airline will be performed at airport) .

Location:

One key issue that has led to the failure of some rail-airport luggage integrated services is the design of the station facility. It was some unsuccessful example where the check-in / registration desks including drop-off and pick up services were slightly off the passengers' natural route from the station towards the airport terminals. This slight detour proved to be enough for passengers to be not worth-while. The desks have been closed as example at the original solution at Paddington Station for the Heathrow Express.

Main design criteria:

Important design aspect is the design of customer interfaces. For reasons of customer confidence in the remote check-in facility of the railway (especially for the full integrated services, door to airport), the facility needs to be designed as much like an airport terminal as possible.

The user interface to the IT system has to present the same functionalities as at airport check-in desk, including production of the airline registration tags.

Currently self-check-in devices are more and more implemented in some airports. As this device will not be connected directly to any BHS conveyors device, it would not offer specific advantages in railway stations.

Illustration 18. Self-checking Automatic device (directly connected to the BHS of the airport, conveyor

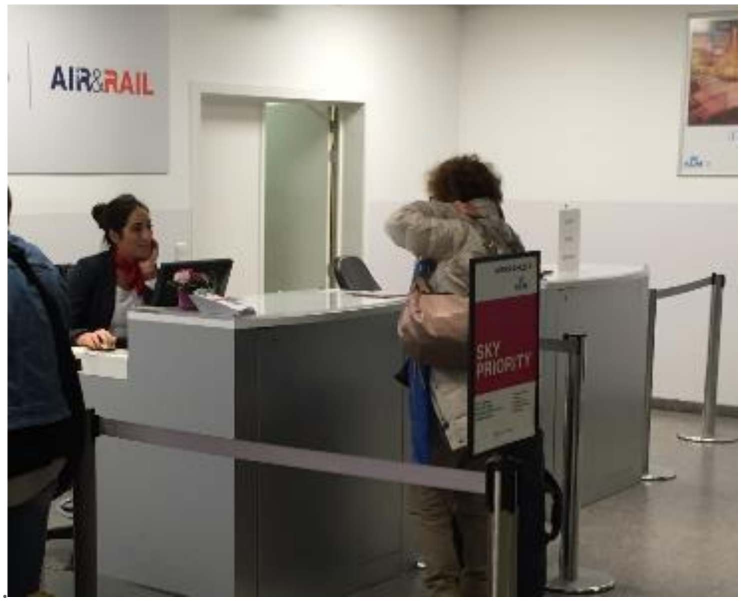


Illustration 19. Air &Rail registration check-in desk at Brussels -Midi station

<u>Luggage storage room in railway stations</u>

Related to A2 and A8 transport segments.

Functional requirements:

Storage rooms in railway stations shall be suitable for the following functions:

- Storage of luggage, the area is dissociated from the check-in desk;
- Interconnection to the check-in desk with a small conveyor belt;
- Easy access for transfer to / from railway platform;
- Protection against loss, theft, vandalism;
- Protection against un-authorized access;
- Luggage tracking, identification;
- Sortation of luggage (especially in the direction airport to home according to train destination and schedule). It could also include a specific place reserved for luggage sortation.

Location:

It is quite usual that the storage room is located close the check-in / registration desk in railway station but usually dissociated from the desk. In airport railway station, where no desk is required, the luggage storage room shall be located not so far from any direct access to platforms.

Main design criteria:

Locked room with access restriction, basic storage shelves. Access to handling devices storage room to platform shall be provided (large doors, flat floor). Restricted direct access via the small conveyor belt to the check-in desk. Equipped with luggage identification and tracking devices. Area dedicated to luggage sortation and loading / unloading of container shall also be provided.

It shall also be considered a significant and dedicated area for container storage, handling by the container tug handling device.

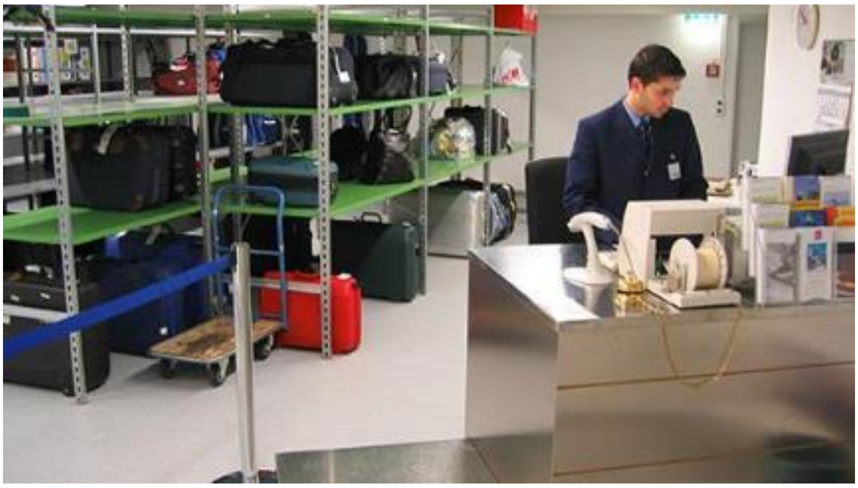


Illustration 20. Luggage storage room in Zurich airport

Luggage carrying / handling device solutions in railway stations

Related to A3 and A7 transport segments.

Functional requirements:

It is considered that the device to be provided shall be an "integrated" solution covering activities handling into / off train board but also the transport from / to the storage room.

Several solutions more and less performant, complex and costly can be implemented according to the luggage volume to be handled each day to / from the train to / from the storage room

Packaging of luggage:

First of all, the packaging of luggage to be transported from the storage room to the platform shall be on the format of trolley cage or container. It is obvious that manual transport of luggage (even for small quantities) is not an option.

It shall be considered that airline controls of luggage (size, weight, number, products) will be achieved in station including airline registration (IATA resolution n°753) but excluding security control.

Some luggage protection measures shall be therefore implemented to prevent any intrusion of objects, protecting tag labels. It could be achieved using more and less costly solution either in the format of container or on the format of trolley cage in both case the container or trolley cage shall be equipped with locking device system to protect luggage during the transport from / the storage room to / from the train.

Illustration 21. Trolley cage equipped with locking device

Containers or trolley cages will be owned by the IM in order to have a common identical pool of container and avoid ownership problems. To avoid the disbalance of container / trolley cage flows which will in any case occur (more passengers are going to the airport than coming back, not the same number of luggage, not using the service for both trips, etc.), one of the solutions could consist in considering that each train shall be is equipped by a fixed number of containers or trolley cages and each station also.

Main principle could be: when loading a (or unloading), a mandatory exchange of containers / trolley cages (of an empty for a loaded one, or in reverse a loaded one against an empty one) could be imposed, and the train shall always carry the same number of containers or trolley cages.

Nevertheless, due to the short dwell time in station of trains (2mn), this solution of "mandatory exchange" is relevant only if the loading or unloading operations do not required more time than available. Otherwise, possible transfer of empty containers or trolley cages shall be anticipated to compensate the unbalance of flows.

One of the key issues, is to identify if the container shall be the same (at least having the same shape) as for airlines and in some way interchangeable. Main container types used in airline industry (to be considered as relevant for railway) are:

AKE type

- Size: L156 x w153.4 x h160 cm;
- Volume: 4,3 m3;
- Empty weight: 75 Kg;
- Maximal loading weight: 1587 Kg;
- Closed by a plastic curtain.

AKN type

- Size: L156 x w153.4 x h157 cm;
- Volume: 3,9 m3;
- Empty weight: 120 Kg;
- Maximal loading weight: 1285 Kg;
- Closed by a metallic curtain.

Both types have in fact the same shape, roughly the same size and are compatible with the loading and fixing system into planes:

Illustration 22. Aircraft container, loaded into plane and locked

Regarding container dimensions, if similar as aircraft is required, major constraints will be to provide very large rolling stock door for loading and unloading, at least 180 cm width to fit with the plane container size. Also, aircraft containers are not rolling ones and a specific interface device shall be provided complementary to the container itself. It shall also be clarified that each airline company is owning its own fleet of containers which are not shared with other airline companies, so it will even less be shared with RB operators.

As a conclusion: to use similar containers as used by airline companies does not provide any specific benefits and is not imposed by any exchange / standardization rules.

<u>Transport of luggage from / to the storage room:</u>

Different solutions can be implemented according to the luggage quantity to be handled by trains:

- The most complex one for large volumes of luggage, handling containers or trolley cages using automated conveyor.

One of the main success of MTR in Hong Kong is that the system is fully automated: there is no need to carry luggage to the platform and to load checked bags onto the train. The whole system is automated from the minute you deposit your bags onto the conveyor at the check in counter, its fed onto the train by conveyor and fed into the airport baggage handling system from the train by conveyor at the airport. It has been operating successfully for more than 20 years.

For RB rail-airport passenger traffic expected, this solution seems to be over-sized and complex because it should be mainly justified by a significant number of luggage to be accommodated and requires also important investments and to install very specific equipment: dedicated luggage conveyors shall be installed, the exact stabling location of the train shall be ensured, the storage on train board is not solved etc.

As example, the following equipment are provided in by the "In-Town Check-In (ITCI) at the A1 Taipei Main Station of Taoyuan metro (back-room of the check-in desks in station).

Luggage carousels, roller conveyors, and luggage lockers at the luggage area on B3 level of A1 station.

At the back of the ITCI service counter there is the luggage conveyor belt and the X-ray system.

Luggage roller conveyor and luggage platform gate at the luggage platform on B3 level of A1 station.

A conveyor belt and a spiral chute on B2 level of A1 Station.

Illustration 23. Luggage storage room in Zurich airport

Another example is currently the “sibag” train concept developed by the company Siemens: Sibag is a baggage handling system that automates the transfer of bags between air and rail travel Through the interconnection of check-ins, conveyors, carousels and container handling equipment integrated into railway stations:

Illustration 24. Sibag solution proposed by Siemens (conveyor, container, with automatic loading into the train)

- Medium size solution with containers or trolley cages handled manually or by an container tug handling device:

This solution is efficient in terms of handling, operation time but a specific attention must be paid to the rolling stock – container – platform interface. An interesting example is the solution which was implemented by Heathrow Express in year 1999 on Class 332 EMU with a dedicated luggage compartment provided on train board where a specific rolling luggage container was push onto board.

Unfortunately, the check-in system in Paddington station was withdrawn few years after coming into service.

Illustration 25. Carrying and loading luggage on train board using a rolling container + Pallet truck handling device

Container or trolley cage moving, handling action can be also based on innovative solutions [13] where the container is not only carried and moved as small trains but can be loaded or unloaded at higher level than the floor using lifting devices included in each container carrying wagon.

Illustration 26. Tug for the transport of containers or trolley cages with lifting system integrated in the wagon

- The simplest solution, manual handling from the trolley cage into the train, small quantity of luggage shall be accommodated:

This solution could be suitable only when very small quantity of luggage should be accommodated in the train. Handling into / off train board could be achieved manually. Trains are is equipped only with a simple luggage compartment locked where luggage is stored during the railway trip. Nevertheless, it should be considered in

13 https://www.k-hartwall.com/products/

this case that some HST train fleet shall be dedicated only on services where low number of passengers using rail-airport integrated services are planned. So, it is more than likely that this solution cannot be implemented.

Illustration 27. Carrying luggage using a simple trolley cage or trolley

Main advantage is simplicity (and cost). There is no need to pay specific attention to rolling stock design (just a luggage area locked). On another hand main, disadvantages are that all handling operations are done manually involving the risk of luggage deterioration. There is also a risk that the time required to move luggage on and off the train will not be compatible with the dwell time of the train in stations (2mn). Carrying heavy loads manually is also less and less favoured in order to protect workers against physical stress. Nevertheless, interface constraints between platform and trains are more limited if luggage is handled manually.

Complementary some device can also be provided to facilitate manual handling operations with telescopic table. This system is used in some airport as a complementary device to download containers on conveyors.

The container is equipped with a lifting table that can be moved with a handle from the container to the lateral or quayside. Emptying a container is even made easier with an extended telescoping table. The user sets the operating table at the desired height, gives the bag a gentle push and the bag quickly slides over the board and down to the conveyor belt.

Despite that handling problems are less critical issues, it remains that the number of handling operations will be the same but loading and unloading operations will take a little less time. Interface problems due to different heights of platform / train levels are also solved.

Illustration 28. Container equipped with a telescopic table

Taking into consideration the above volumes of luggage, it is more than likely than an automated conveyor even in the busiest station will not be required. Probably manual handling of containers will be achieved or using the container tug handling device.

Platform design in railway stations, loading and unloading aspects

Related to A3 and A7 transport segments.

Functional requirements:

Considering the railway rolling container solution recommended in the previous chapter, main issues are to provide the most direct access to loading area into the train.

Platform height compared to rolling stock floor height is a key issue. This is addressed in the report "Peer review of the operational Plan Concept for Rail Baltica railway".

Location:

All railway stations platforms where HST long distance trains will stop should accommodate rail-airport integrated passenger services.

Main design criteria:

Rules are described in several UIC documents (UIC 741 for the platforms and UIC 560 for the rolling stock in order to ensure compatibility between the level of the different steps of the access stair and the rolling stock, the longitudinal position of the edge of the platform, etc.

By construction, the rolling stock floor is usually set up at a range of height above 780 mm in order to set up the bogies under the body structure and to provide also the most uniform flat floor inside the vehicle. Lower access values are of course proposed by rolling stock suppliers but make the design more complex with a set of ramp, steps or stairs inside the vehicle (typically the case with double deck rolling stock where there is a need to use the full rolling stock height available).

With a value of 760 mm for the platform and 780 mm for the rolling stock floor, the optimum solution is provided in terms of accessibility for the rolling container and it could be similar as the following:

Illustration 29. Direct access to 760 mm height platform (Coradia)

Some interface device (retractable step) to fill the lateral gap between the platform edge and rolling stock shall also be specified for the rolling stock.

Illustration 30. Platform Gap filler

For full automated conveyor, there is no problem identified, it is supposed that containers or trolley cages will be loaded and unloaded automatically at level by the conveyor.

For other solutions, if it is confirmed that RB platform height will be 550mm, and in all cases when some vertical gap could exist (more than 5cm), additional provisions shall be provided if either:

- Partial higher-level platform. This solution is not recommended or shall be “removable” if rail-airport integrated services are not a success. Two height level of platforms for the same platform is not a usual and recommended solution or shall be limited to end platform only;
- Mobile ramp with a maximal gradient of 8 %. As example with a 550mm platform height and 780mm rolling stock floor height, the length of this ramp shall be about 2800mm to prevent any risk during container / trolley cage handling. This solution is not recommended also taking into account the short dwell time of train in stations.
- The best solution, whatever is containers or trolley cages are handled manually or using also container tug handling device solution is to have a lifting system integrated inside the wagons (or support trolley) to lift at train level the container or trolley cage.

WP 4.7 - Discussion of implications for station infrastructure

Requirements for luggage management within stations

Whatever will be the alternative implemented (partial integrated services or full integrated services), the following recommendations are expressed in the aim to facilitate the RB luggage management within stations. It is considered that RB's IM will be in charge to manage rail-airport integrated services.

<u>**Station – train operation management:**</u>

Because the dwell time of trains stopping in RB stations will be short, limited to 2mn, the railway operator shall face specific constraints to accommodate rail-air integrated services. Mainly this dwell time shall be "secured" including loading and unloading operations of containers or trolley cages.

In a practical way, several problems may occur as far some human handling factors will be observed:

- The container is not loaded or not unloaded on time on train for several reasons (last minute change of platform, delay of train changing the loading / unloading schedule, luggage management service not informed on time, etc.);
- The container is loaded or unloaded not in the correct station;
- There is no tracking of luggage according to a specific container;
- There is no reliable transfer of information from / to the station sender and station receiver regarding the fact that some container loading or unloading is required;
- There is no reliable "loopback" in case of problems (luggage lost, luggage delay, passenger not boarding, luggage registration tag lost, luggage refused by airline, etc.).

So, handling operation process shall be made robust and human reliability and seriousness is not reliable. Supported by IT solutions, the following is recommended:

- Full luggage tracking: luggage tag associated with container number;
- Container number associated to train number, station identification code;
- Records of loading / unloading operation / time, location;
- Dispatch notice from sender to receiver;
- Train departure authorization conditioned / linked to luggage handling operation;
- Loopback / feedback procedures to improve procedures should also be incorporated.

A simplified form of a “dispatching” software could be implemented with similar functionalities as Enterprise Resource Planning (EPR) used for logistics and freight forwarders.

The objective of the system is to automate the end to end process of the logistics service providers, reduce errors and ensure zero paper-work involved. By integrating all administrative & operational data into this system logistics service provider’s / freight forwarder can automate and streamline their transportation operations.

General requirements for RB station infrastructure

Target time for the implementation of RB rail-airport passenger services shall be set-up in 2 phases:

- First of all, **physical reservations** shall be planned in the design of railway station, platform, rolling stock and in general all RB components concerned by rail-airport integrated services.
- Second, when rail-airport services will be considered to offer **sufficient financial sustainability, the implementation can start**, limited first to stations where services will be significant and extended progressively to other stations.

Regarding the target time of starting integrated services, it has been observed that the reasons of most of abandoned services were financial sustainability and it is recommended to achieved a detailed business case study supported by a cost benefit analysis study and state preference survey to make more robust the assumptions of this feasibility study and assess at which level of passenger volume the financial sustainability will be ensured.

It should be noted that in year 2026, when RB services are expected to start, forecasts of passengers using rail-airport integrated services show important discrepancies regarding the potential volumes to be accommodated each day with quite low figures.

<u>Railway stations, registration desk sizing:</u>

For rail-airport service integration of services within the design of railway stations concerned, it shall be considered the following figures (refer to Annex):

Scenario rail-airport integrated services (passenger trip volumes):									
Years	Scenario	Tallinn	Pärnu	Riga central	Riga RIX	Panevėžys	Kaunas	Vinius	Poland
2026	Scenario pessimistic 5 % , per day	8	11	28	39	22	29	17	2
	Scenario medium 15 %, per day	25	32	85	116	65	86	52	7
	Scenario optimistic 25 %, per day	42	53	141	193	108	143	87	12
2036	Scenario pessimistic 5 % , per day	23	29	79	105	56	73	44	6
	Scenario medium 15 %, per day	68	86	236	316	168	219	133	18
	Scenario optimistic 25 %, per day	113	144	393	527	279	365	222	30
2046	Scenario pessimistic 5 % , per day	24	31	88	116	58	76	46	6
	Scenario medium 15 %, per day	73	93	264	348	175	228	138	19
	Scenario optimistic 25 %, per day	122	156	440	580	292	380	230	31
2056	Scenario pessimistic 5 % , per day	26	33	98	127	61	79	48	6
	Scenario medium 15 %, per day	78	100	294	382	183	236	143	19
	Scenario optimistic 25 %, per day	131	167	491	636	305	393	238	32
	Maximum value	**131**	**167**	**491**	**636**	**305**	**393**	**238**	**32**

Table 7. **Passengers using rail-airport integrated services in railway stations**

But even considering the highest and most optimistic values, 18 working hours per day in each station, it gives the following passenger volumes at rail-airport desk(s) per hour:

Tallinn	Pärnu	Riga central	Riga RIX	Panevėžys	Kaunas	Vinius	Poland
7	9	27	35	17	22	13	2

Table 8. Passengers at desk using rail-airport integrated services in railway stations, year 2056, most optimistic scenario

Considering 2 or 3mn for passengers for check-in operations (or to pick-up luggage), only Riga central, Riga RIX, Kaunas station should face at term more passengers and would require in year 2056, for the most optimistic scenario, 2 registration desks to face peak hour demand.

It is estimate that the surface required to implement registration desk in railway station shall be approximatively 10 m^2 (2 agents, small belt conveyor connected to the storage room).

Luggage storage room sizing:

- Luggage collecting and sortation activities:

Considering the current rules of maximum luggage per passenger (2 luggage, 158 cm cumulated dimensions = 0.1m3), shall be stored out of containers waiting to be sort and loaded into container or waiting to be picked up by passengers. Turnover considered is no more than 2 hours during a period of 18 working hours of the station.

Station	Tallinn	Pärnu	Riga central	Riga RIX	Panevėžys	Kaunas	Vinius
Number of passenger per day	131	167	491	636	305	393	238
Number of rail-airport passengers hour	7	9	27	35	17	22	13
Number of luggage per hour	15	19	55	71	34	44	26
Number of luggage on average (2 hours turnover within the room)	29	37	109	141	68	87	53
Volume required (m^3)	2,90	3,70	10,91	14,14	6,77	8,73	5,29

Table 9. Passenger luggage using rail-airport services in the storage room of each station, year 2056, most optimistic scenario

A fixed value of $10m^2$ will be considered for this temporary zone of luggage storage out of containers. To this volume, it shall be added some additional space to accommodate the storage room desk and end part of the conveyor inside the storage room. A fixed value of 5 m^2 more will be considered.

- Container or trolley cage management:

Passenger operation plan patterns proposed in the Operation Plan shows that in some cases, the same trainset could accommodate during the same trip several "Origin-Destination" of containers. Typical example is for some trains from Tallinn to Riga airport passing by Pärnu. The same trainset will accommodate "Tallinn- Riga airport" container (luggage checked-in in Tallinn) but also "Pärnu-Riga" container. In any case, the dwell time in station (2mn) will be sufficient to load or unload manually some luggage into / from the same container having as destination Riga airport.

Train Category / Line No.		Service Interval [Minutes] Peak	Service Interval [Minutes] Off Peak	Train pairs/day	Warszawa	Bialystok	Ełk	Suwałki	Marjampole	Kaunas	Vilnius	Panevėžys	Bauska	Riga Airport	Riga Central	Skulte	Salacgrīva	Pärnu	Rapla	Tallin Ülem.	Helsinki
HST	11	120	240	4	●	●		●		●		●		●	●			●		●	
HST	12	120	240	4							●	●		●	●			●		●	

Illustration 31. HST train operation pattern (year 2026)

From the theoretical point of view, for each station concerned by Rail-airport services, dedicated O-D containers for each other Origin or Destination station shall be provided.

In the above figure, Kaunas station will accommodate specific containers having an Origin or a Destination from / to Vilnius, Panevėžys, Riga RIX, Riga, Central, Pärnu and Tallinn (6 specific O-D containers) including containers "going to" and "coming from". It leads to a significant number of containers per luggage storage room which are under loading or unloading process.

For stations which are not railway airport ones, as Panevėžys, this number will be less because no specific rail-airport services are provided between these stations. Only 4 O-D containers will be required (Kaunas, Vilnius, Riga RIX, and Tallinn).

It is questionable if specific O-D containers shall also be provided between railway airport stations themselves (passenger from Kaunas to Tallinn airport ?) but for the purpose of this feasibility, it is considered that it could be possible.

HST train operation pattern of the operation plan shows a significant number of trains per day in each station. Kaunas and Vilnius in year 2056 should offer up 26 trains per day (both directions) and other stations 16 trains. The total combination of O-D containers per station and trains gives significant maximum turnover of O-D containers which may be accommodated by each luggage storage room during a day (Kaunas, 6 O-D and 26 trains = 156 different O-D containers).

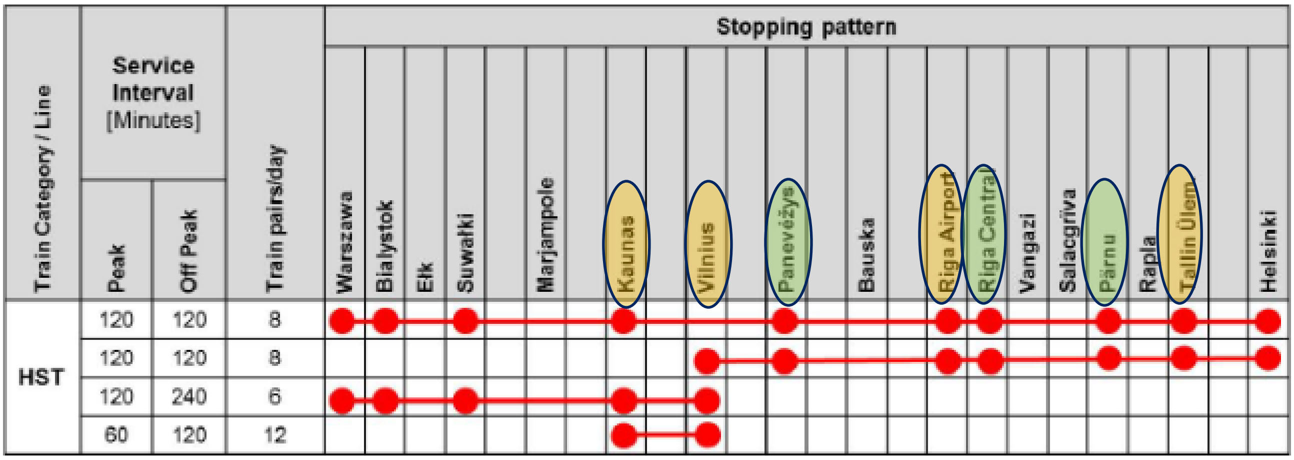


Illustration 32. HST train operation pattern (year 2056)

Turnover of containers shall be considered, in principle each one being dedicated also for a specific train of the day and staying few hours in the station to be loaded or unloaded and when unloaded re-used to be loaded for another train. The storage room shall work efficiently as a “marshalling yard” of “mail sorting facility” for containers.

It means also, that each container shall not be dedicated and identified for a specific O-D (and moreover for a specific train). An identification number shall be allocated individually to each container, this number being used by the I.T. system for the allocation of luggage tag and allocation to a specific train.

Rail-airport station	Tallinn	Pärnu	Riga central	Riga RIX	Panevėžys	Kaunas	Vinius
Number of trains per days (both directions)	16	16	16	16	16	26	26
Number of O-D connection to airport stations	6	4	4	6	4	6	4
Maximum number of different O-D train containers per day to be accommodated by the luggage storage room	96	64	64	96	64	156	104
Average number of O-D train containers per hour (18 working hours per day)	5	4	4	5	4	9	6

Table 10. **Container turnover in the storage room of each station, year 2056, most optimistic scenario**

For the most optimistic scenario, in year 2056, between 4 and 9 O-D containers are supposed to stand per hour in each luggage storage room of each station. It is considered the following size of containers L150 x w70 x h160 cm, roughly 1m^2 (1,68m^3) and each container is able to accommodate about 10 to 15 luggage.

In addition, it shall be considered some operational surface reserve to move the containers inside the storage room, and to be handled by the container tug handling device.

The following surface to be reserved for the luggage storage room of each station to face rail-airport services at term (optimistic scenario year 2056) are:

Rail-airport station	Tallinn	Pärnu	Riga central	Riga RIX	Panevėžys	Kaunas	Vinius
Average number of O-D container per hour (18 working hours per day)	5	4	4	5	4	9	6
Unit surface each container (m^2)	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Total surface allocated to container storage (m^2)	5,33	3,56	3,56	5,33	3,56	8,67	5,78
Operational reserve (m^2)	30,00	20,00	20,00	30,00	20,00	40,00	35,00
Storage place for sortation of luggage (m^2)	10,00	10,00	10,00	10,00	10,00	10,00	10,00
Management desk + conveyor (m^2)	5,00	5,00	5,00	5,00	5,00	5,00	5,00
Total surface (m^2)	**50,33**	**38,56**	**38,56**	**50,33**	**38,56**	**63,67**	**55,78**

Table 11. **Size of each luggage storage room of each station, year 2056, most optimistic scenario**

Management of containers:

- The luggage storage room size and in general station management of rail-airport services will be more impacted by the number, turnover of containers to be handled (minimum one for each O-D, each train) than by the volume of luggage to be handled.
- In some way, the luggage storage room will become a "marshalling yard" for containers or "mail sorting facility".

Pathway between luggage storage room to platform:

Management, transfer of containers between the luggage storage room to trains will generate at term significant container transit operation between trains and the luggage storage.

The number of transit operations is directly related to the number of trains concerned by rail-airport services (16 or 26 trains per day, both directions in year 2056). Considering 18 working hours, it remains nevertheless in the range of 1, to 1,5 container transit operation per hour.

Therefore, it could not be considered that "pathway" congestion will exist with other needs to provide safe and dedicated pathway for container transit operation using a container tug handling device.

Whatever is the technical solution chosen (simple rolling cage, rolling container, container tug handling device for the transport of containers or full integrated automated conveyor), some common constraints shall be considered:

- From floor level to platform level (if not at the same level), long ramp having a maximum gradient of 4% (manual handling) to 10 % (electrical truck) or lifts (only from one to one container or trolley cage handling);
- Minimum path width (2 ways for the container tug handling device in charge of the transport of containers + 2 pedestrian paths), about 4 meters.

Platform sizing:

Same comment as for pathway sizing, the number of handling operation per hour is limited and moreover, dwell time of trains staying in station also limited. It shall be considered that the end part of each platform will be allocated for this activity, not interfering with passenger boarding and protected by removable barriers.

Functional simplicity:

A fundamental criterion the integration of rail-airport passengers services within railway station is clarity and ease of use. Crucial design components should be organized logically so the average user is able to accomplish basic tasks from reaching the railway station area, to identifying their transit needs, purchasing the ticket, and boarding the train. The reverse situation is also applicable, where a rail-flight passenger gets off the train.

Requirements regarding pedestrian accessibility:

One of the common key issues which requires specific care is pedestrian accessibility in general whatever if they are user of rail-airport integrated services or not. Pedestrians should receive the highest priority since they are the primary users of transit systems and stations. Pedestrian environments should be designed with safe, clear, and unobstructed connections to the station and airport areas. Non-fragmented and integrated pedestrian paths to the railway station will encourage more passengers to walk and can increase the rail-airport ridership without the need for additional parking facilities or bus service;

Requirements regarding Person with Reduced Mobility (PRM):

The technical specification of interoperability (TSI) relating to "persons with reduced mobility in the trans-European conventional and high-speed rail system" shall be considered a minimum not only for passenger users of rail-airport integrated services but in general for all users;

Requirements regarding Inter-platform circulation:

The decision to locate the major zone of pedestrian circulation above or below the level of the rail tracks and platforms is one of the most fundamental decisions affecting station typology. Typical above ground rail stations adopt a strategy of locating the transverse concourse as an overpass spanning over the tracks with connections down to each platform, or an underpass located below the level of the tracks with connections up to each platform. An underpass concourse offers different challenges. People have an inherent reluctance to descend below general ground level and a resistance to enter tunnels in many cases;

Requirements regarding Station Safety:

Trip and slip hazards can lead to falls particularly when exacerbated by haste or crowding during peak hours and emergency situations for passenger in a hurry to catch a flight (or a train) and loaded with luggage. Designers can reduce risks by removing trip hazards and installing visually contrasting edges and grab rails. Design all paths shall have sufficient width for peak hour traffic for the expected lifespan of the station.

Specific requirements regarding railway airport stations:

It is classical that railway stations are implemented after the construction of the airport which involve lot of integration problems because airports are quite reluctant to engage major reconstruction works in existing airport facilities. Therefore, such railway stations are constructed as additional parts of airport buildings and some facilities with selected design elements adapted from the airport terminals to these stations. Obviously, the space provided must be sufficient to meet the needs of air-travel passengers who need extra facilities for luggage. It could lead to the development of the railway station (insofar as possible) close to the airport but in some cases, this is not possible and it is not that close. Travelators are useful for passengers with prams or laden with luggage and should be considered at airport and railway interchange stations where space allows in order to provide better integration if physically the railway station is not integrated in the airport building;

Specificities of RB stations serving Airports

Tallinn Station:

Tallinn Ülemiste station is located at the northern endpoint of Rail Baltica. The railway station is situated in the suburbs of Tallinn within short distance to Tallinn airport (about 600m). Tallinn Airport, since September 2017 has a direct tram connection to Tallinn downtown (with intervals of 6 minutes, journey taking by 30mn to railway station). RB station will not be integrated in the airport terminal and located about

Illustration 33. Tallinn airport - tramway connection to the airport

Illustration 34. Existing tramway loop integrated in the terminal structure -

The existing tramway connection, recently (2017) refurbished and extended to the airport is passing under the railway lines 1520 mm by and underground passage (150m) with possible access for road vehicles.

Illustration 35. Tramway underground passage under 1520mm railway lines

A public transport hub has been opened at the airport for light rail and buses. It connects to the new tram by a gallery with escalators. The new transport hub eases traffic conditions and provide new options for passengers travelling to and from the airport.

Illustration 36. Tallinn airport tramway at airport

Rail Baltic rail corridor is planned to be parallel with the existing rails, it will be placed on Southern side next to Suur-Sõjamäe Street. Ülemiste station will accommodate 1520 and 1435mm tracks.

Ülemiste station is located about 500 meters far from the airport without dedicated pedestrian path. Tramway line is not so far but also without intermodal development yet.

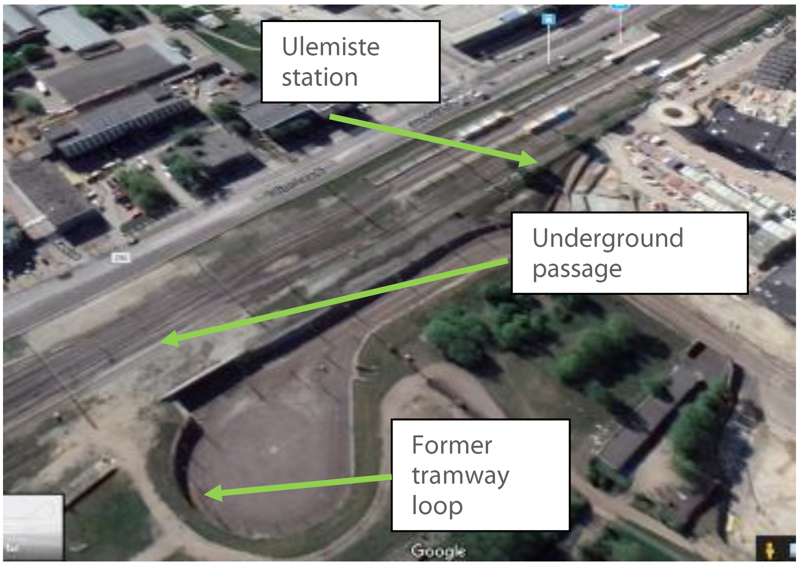


Illustration 37. Ülemiste station, tramway connection

So far, main issue to be solved will be to in general to implement better connection between Ülemiste station and the airport. The distance of about 500 meters is in some way "too much short and long". Pedestrians without luggage will enjoy in good weather condition to go walking but passengers having luggage or not so keen walking would prefer using tramway connections.

Luggage transfer of rail-integrated services can be either achieved using the tramway vehicles or "cargo tram" but more than likely that only tramway infrastructure will be shared with road electrical vehicles.

Illustration 38. Tramway underground passage

Illustration 39. Tramfret test in Saint Etienne (France)

Few more examples are also identified[14].

Riga central station and Riga airport station:

Riga airport station (RIX) will be located close to Riga International Airport.

Rail Baltica railway station at Riga airport shall be located on a viaduct (stretching across all the airport territory for 2 km) on the same level with the perspective terminal's check-in hall. A 400 m platform is provided that shall ensure service of the international and short-distance (incl. shuttle) trains. The shuttle and the Regional trains (please refer above illustration Passenger train service pattern in 2036/2046) shall be timed such that a service with regular time intervals between Riga Central and Riga Airport can be provided (at least half hourly).

[14] https://www.eurogunzel.com/2018/09/freight-trams-of-europe/
https://www.railfreight.com/railfreight/2019/08/22/tram-for-freight-transport-in-bremen/

Illustration 40. Riga International airport extension project integrating RB connection (source RIX Business plan 2015 - 2036)

Typically, services provided to be considered are "Shuttle" railway trains connecting the main railway central station to airport railway station (RIX).

There are currently different means of transport to reach the airport:

- Bus No. 22 from the Old Town
- Riga Shuttle Bus with Minivan service that goes from Riga Airport to city center hotels
- Mini-Bus route n°222. This minibus goes from just outside arrivals to Central Bus Station via Stockmann.

A plan to build a "high speed tram" is also one option to be implemented.

Kaunas station:

Kaunas airport is the second largest airport in Lithuania and is located 14km north east of the city centre.

There are also plans to enhance the airport's throughput both passengers and freight. The location allows for physical expansion of the infrastructure to facilitate further growth. Current plans envisage a new cargo warehouse to be built on the North side of airport, to the EAST from current terminal.

Despite the relative proximity to Kaunas city centre, average journey time by car is approximately 45 minutes due to significant congestion around the airport. A regular bus service to the city centre is also available.

Currently provision of a 1435 mm link to Kaunas airport is under discussion. This would mean that Rail Baltica trains would continue to Vilnius airport station after a short stop incl. change of direction.

Another alternative developed in AECOM Rail Baltica- Feasibility Study - Amendment – Analysis of Vilnius Extension (2014)[15] is to have Kaunas Airport connected to Kaunas airport Station (KUN) via bus shuttle service (10mn trip). Rail-

[15] alignment proposed by SWECO

Airport service will require an additional transport segment (from the railway airport station KUN to the airport terminal), using dedicated road vehicles suitable for the transport of luggage containers.

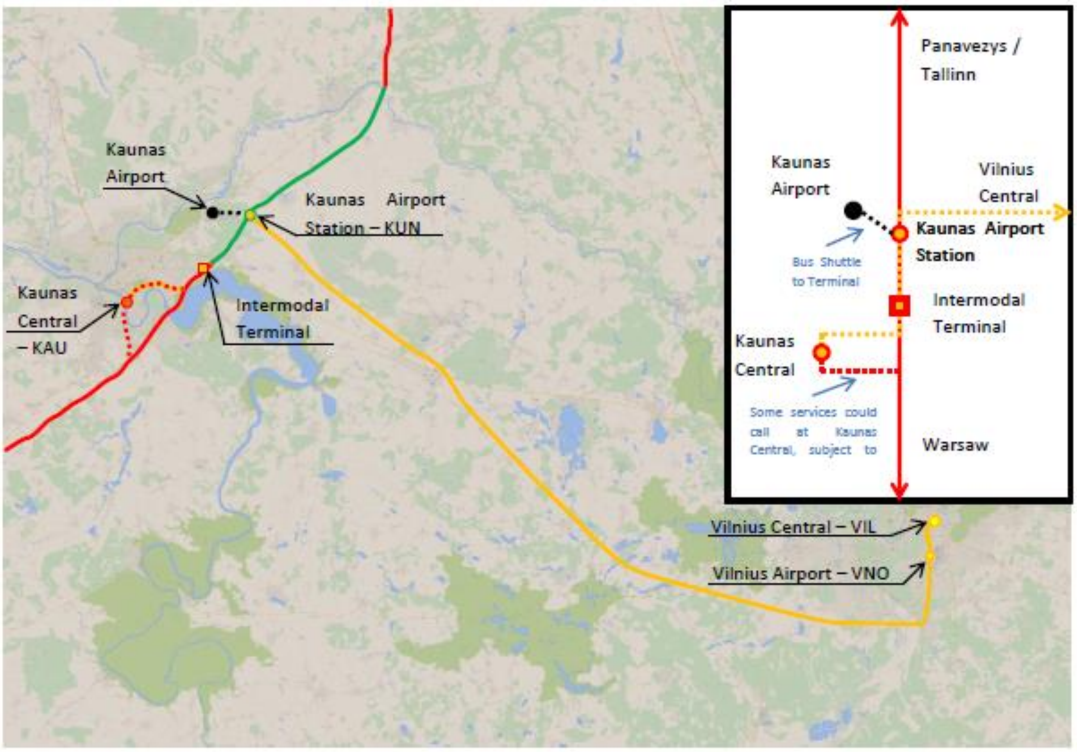


Illustration 41. Kaunas airport – AECOM study Vilnius extension

Vilnius station:

Direct train services between Vilnius Airport Railway Station and the central station of Vilnius were started in October 2008. Distance from the Airport to the Central Railway Station is 4,3 km (2.7 mi), the journey takes 7 minutes. This is the fastest way to reach the Airport from the city centre.

Current location of railway station 1520mm is quite close to the terminal (about 200m) but cannot be considered nevertheless as being fully integrated. A half covered pedestrian path is offered, including a lift to reach the platform at lower level. 1520mm track gauge is a single line, non-electrified and train frequency is 45mn and travel trip about 7mn for a cheap price less than 1 Euro.

Illustration 42. Vilnius airport – railway station 1520mm , distance

Illustration 43. Vilnius airport – railway station 1520mm gauge - covered pathway

Illustration 44. Vilnius airport existing railway station (1520 mm track gauge)

During the assessment performed by the Consultant, it was assessed that the airport railway connection is not "a busy place". Most of passengers are preferring using buses, cars, taxi because the main station of Vilnius is not the original place where airline passengers are coming from.

There still some discussion yet about of Vilnius airport will be connected with some HS trains in 1435 gauge, specific shuttle trains 1435 mm or using the existing 1520mn to be improved.

In any case, integration of rail-airport services remain an issue if the existing facilities in the area of Vilnius airport are re-used and adapted for the transfer of luggage.

WP 4.8 - Recommendations for any changes to Design Guidelines

It has not been identified any change required in the current design guideline criteria of RB, length of platform is station will still be limited to 405 m.

Despite that the Design Guideline is not covering such details of design, implementation of Rail-airport integrated services will involve some changes in the design of stations as adding a storage room, access paths between the storage room for the transport of containers and also specific requirements regarding HST rolling stock design.

WP 4.9 - Detailed description of any implications or requirements for rolling stock

General recommendations for rolling stock

Please refer also to WP 4.3 regarding general requirements for the rolling stock design.

Detailed description of any implications or requirements for RB rolling stock

As for the luggage storage room of stations several parameters shall be considered and combined regarding the size of luggage compartments of trainsets. It shall also be taken into consideration that two luggage compartments shall be provided, one at each end the trainset, to preserve rolling stock reversibility functionality:

- The different number of specific O-D containers to be handle in each station, per direction;
- The number of passengers per day (each passenger having maxim 2 luggage);
- The number of luggage per passengers;
- The number of trains per day.

The following table gives an overview for each rail-airport station in year 2056, optimistic scenario of this combination:

Rail-airport station	Tallinn	Pärnu	Riga central	Riga RIX	Panevėžys	Kaunas	Vilnius
Number of O-D possibilities to other rail-airport stations[16]	6	4	4	6	4	6	4
Number of passengers per day (one direction)	65	83	245	318	152	196	119
Number of luggage per day (one direction, 2 luggage per passenger)	131	167	491	636	305	393	238

[16] Please refer to "luggage storage room sizing" chapter

Rail-airport station	Tallinn	Pärnu	Riga central	Riga RIX	Panevėžys	Kaunas	Vilnius
Number of trains per days (one direction)	8	8	8	8	8	13	13
Average number of luggage per trainset	16	21	61	80	38	30	18
Average number of containers required (10 luggage per container)	0,34	0,65	1,92	1,66	1,19	0,39	0,35

Table 12. **Combination of parameters to be considered for luggage compartment sizing**

As for the luggage storage room in station, despite that on average there is a maximum need of 2 container to be accommodated to face the luggage volume, more containers will be required to face the diversity of Origin-Destination of passengers (in simple words, most of the containers will far to be full).

As example, for Tallinn railway airport station, on average 65 passengers per day (one direction) will use rail-airport integrated services. Each passenger is travelling with 2 luggage, so in total 131 luggage per day. It could be considered that a correct balance of passengers and luggage is observed between the different trains (8 trains per day in one direction which gives on average 8 passengers per trains and 16 luggage).

But each passenger has the choice between 6 destinations and there is a possibility that 6 different O-D containers will be required and loaded in Tallinn station in the same train.

In the worst case, it could be observed a "peak-demand" for a specific train during the day, the current number of passengers per days reflecting only a daily average. It should be considered in this case not only that several containers shall be provided to face the diversity of O-D but also several containers for the same O-D if more than 10 or 15 luggage shall be transported by this train.

The combination of "peak-demand" associated to the requirement to face "diversity of O-D" leads to some crazy figure as for example for Tallinn railway airport station:

- All 65 passengers of the day are travelling by the same train with in total 131 luggage;
- 5 of them are going each to Pärnu, Riga Central, Riga RIX, Panevėžys and Kaunas (5 O-D container required, each container 2 luggage);
- 60 other passengers are going to Vilnius (for an unknown reason) with 120 luggage. So, 12 "Tallinn-Vilnius O-D container shall be loaded.

In total and theoretically, a place for 17 containers shall be available on train board.

To size the luggage compartment, the turnover of O-D containers in each station where some of them will be loaded and some other unloaded shall be considered. As example, during a full trip from railway airport station of Tallinn to railway airport station of Vilnius:

- Rail-air passengers from Tallinn railway airport station will have the choice between 6 different destinations (6 other rail-airport railway stations). To face this diversity of destinations, considering that only 1 container will offer sufficient capacity, 6 different O-D containers will be loaded in the train.
- At the next station Pärnu, some passengers are leaving the train (they were coming from Tallinn airport), so 1 O-D container (Origin Tallinn) will be download from the train. But in Pärnu, some additional rail-airport passengers are boarding on the train. 3 additional O-D containers we be loaded (destination Riga RIX, Kaunas, or Vilnius). Only railway airport stations are considered to be a possible of rail-airport passengers.
- At the next station Riga Central, some other passengers coming from Tallinn railway airport station are leaving the train, 1 O-D container (Origin Tallinn) is downloaded but also some passengers are boarding and 3 additional O-D containers are loaded (destination Riga RIX, Panevėžys, Vilnius).
- At Riga RIX, some passengers are leaving the trains, O-D containers from Tallinn, Pärnu, Riga Central are downloaded, and so on….

Rail-airport station	Tallinn	Pärnu	Riga central	Riga RIX	Panevėžys	Kaunas	Vinius
O-D container loaded for this direction	6	3	3	3	2	1	0
O-D container unloaded for this direction	0	-1	-1	-3	-2	-5	-6
Total number of O-D containers on train board	**6**	**8**	**10**	**10**	**10**	**6**	**0**

Table 13. **Year 2056, optimistic scenario, turnover of container inside the luggage compartment**

In fact, up to 10 different O-D containers will stand in the luggage compartment during the Tallinn- Vilnius trip theoretically just if the diversity of O-D must be faced.

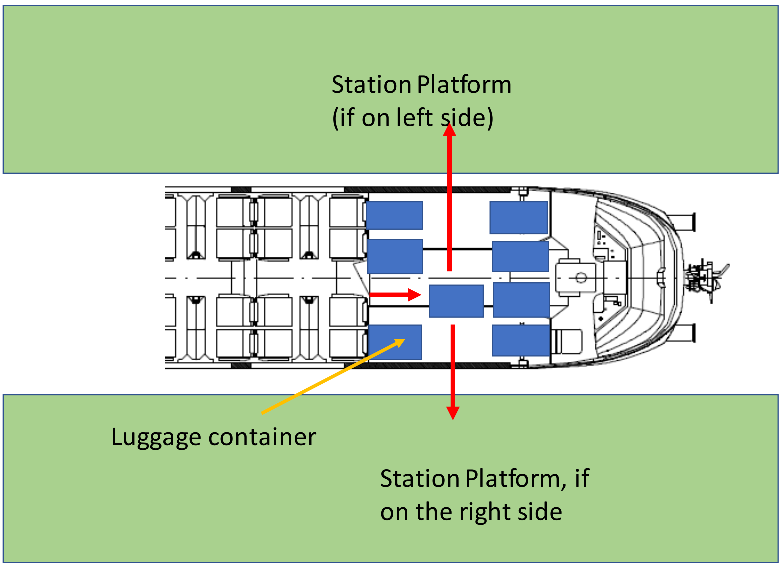
It is obvious that, if it is considered the combination of the worst case with peak-demand for some specific trains in addition with the diversity of O-D containers, the number of containers which must be accommodated by a single trainset will be beyond 50.

To date, there is no specific State preference surveys to assess peak-demand and even Origin-Destination demand of rail-airport passengers. As assumption, it is considered that all passengers will be well balanced between daily trains in the same direction. It is also considered that ate least all diversity of O-D containers shall be offered on board of each trains.

In case of peak-demand or unbalance of O-D demand, it could be implemented the following:

- Management by the IT system: as for trains when all luggage places in a specific O-D container are sold for a train, it will not be accepted more luggage;
- Possibility to use the second luggage compartment but in this case 2 loading / unloading zone in station shall be provided.

It is supposed therefore that maximum 8 different O-D containers will be accommodated by each luggage compartment, with a total capacity of 80 to 120 luggage with the following disposition and approximative dimensions:



	1, 5m	2m	1,5m	Total 3,5m length
0,7	Cont.O-D 1	boarding zone in the compartment	Cont. O-D 5	
0,7	Cont. O-D 2		Cont. O-D 6	
0,7	Cont. O-D 3		Cont. O-D 7	
0,7	Cont. O-D 4		Cont. O-D 8	
Total 2,80m width				

Illustration 45. Size of luggage compartment on train board (tentative)

The size of containers or trolley cages will also be designed according to the rolling stock constraints (height of doors, width, etc. in the most convenient way to be accommodated by rolling stock and transfer within the stations.

The maximum operational width of the luggage compartment door could be in the range of 2m. The luggage container size could be about:

- Size: L150 x w70 x h160 cm;
- Volume: 1,8 m3;
- Empty weight: 35 Kg;
- Maximal loading weight: about 500 Kg;
- Closed by a metallic curtain locked;
- Capacity of bags (compliant with airline size), about 10.

The luggage compartment itself, if securely protected against theft, vandalism and un-authorized access could be itself sufficient. In addition, the container shall be safely secured regarding any movement when then train is running, braking with fixed locking points.

Illustration 46. Luggage container (example)

About 10m² for each luggage compartment is required, 25 % of a trainset car, a trainset being composed by 7 or 8 cars.

Even if the luggage compartment will occupy a limited place within the trainset (in total for both compartments half a car), a very prudent approach is recommended. It would be a scandal, if for example, "for-ever" dedicated luggage compartments are provided in each trainset and if rail-airport integrated services are not getting the hoped success (the same as in some HST where "bar" coach is provided but the bar always closed because it was not profitable).

Luggage compartments shall be designed to be converted easily through minor modifications into passenger area if rail-airport integrated services are facing a low success. So, "flexibility" shall drive the requirements regarding the rolling stock.

Possibility to use modified passenger vehicles

They are few examples to have railway passenger cars modified or partially converted into luggage transport purpose or mainly limited to old rolling stock HST. From the technical point of view "all is possible" but it will not be limited to remove existing seats and adding some panels to close the luggage compartment.

One of the main modifications is probably the size of existing access door. Based on the layout proposed in the above chapter, large doors on each side shall be provided. In addition, Container locking system on floor, guiding rails shall be installed also.

It is estimated that such modification could cost at least per EMU car about Euro 0,3 million.

Interesting example is the Mercitalia Fast train for goods

In November 2018, the operator's Mercitalia Logistics (Gruppo FS Italiane) has launched the world's first high-speed rail service dedicated to freight.

Running on the pre-existing Italian High Speed/High Capacity network currently in use for passenger trains, the service will connect the southern terminal of Maddaloni-Marcianise, near Caserta, to Bologna, one of the country's most important logistics hubs, in three hours and 30 minutes overnight.

For this particular and innovative service, an ETR.500 (now classed ETR M-01 Fast), consisting of the two engines E.404.514 and 516, and its 12 passenger cars were emptied of their seats in the workshops of Vicenza and Voghera. The air conditioning system and static converters for 220 Volt production for onboard services and power outlets have been removed. This lightering had to be offset by 3.6 tons of ballast to maintain stability.

These new trains are designed to transport time-sensitive products for customers such as express couriers, logistics operators, producers, distributors and real estate developers.

Each car has 17 loading areas called "racks" and numbered progressively from 1 to 17, for a total of 60 containers (71x80x180), approximately 1m^3 or 250 kg, easy and fast to load and unload. This maintains the 17 tons at the axle required on high speed line. Yellow tubular structures delineate the rack and allow anchoring of the containers with special ratchet straps supplied to each container. The standard load capacity is 7 tons per vehicle, but in case of transport of heavier goods, it is possible to remove the ballast

Illustration 47. Loading areas in the car

Illustration 48. Access doors

Illustration 49. Parcels loading using trolleys

Annex: Market analysis

Despite no being required in the ToR to be included in this final report , market analysis developed and presented in the interim report is included in the final report in order to make it self-explicit without referring to the interim report.

Preliminary Market Analysis

The following documents have been provided by RB and have been considered by the Consultant for the preliminary market analysis:

- Operational Plan Concept for Rail Baltica railway, ETC Gauff Mobility, 2018
- Initial Concept and Proposed Process Flows (attached as Appendix)

The above documents include also the screening of existing studies of passenger traffic and freight traffic respectively. The latest study from 2017 named "Rail Baltica Global Project Cost-Benefit Analysis (CBA)" prepared by E&Y is considered the best basis for this Operational Plan.

Usage forecasts to be considered for the development of rail-airport integrated services, as planned in the operation plan [17], are presented in the following illustration. In the context of this feasibility study, rail-airport integrated services are at this stage considered for a short-term overview, other horizons showing simply an increase of the number trains per day, for Origin-Destination pairs without any specific or additional services (all lines will be operated in next stages with the exceptions of HEL shuttles between Tallinn and Helsinki as the FinEst tunnel will not be realized before 2056).

RB's plan, to be considered in the feasibility, is to have a full rail-airport integrated service in regular railway stations not close to the airport as Tallinn, Pärnu, Riga, Panevėžys, Kaunas and Vilnius. Therefore, airports to be considered are Tallinn, Riga, Vilnius and Kaunas ("the Airports") and stations to be considered are Tallinn, Pärnu, Riga, Riga Airport, Panevėžys, Kaunas and Vilnius.

17 Refer to Operational Plan Concept for Rail Baltica railway, ETC Gauff Mobility, 2018

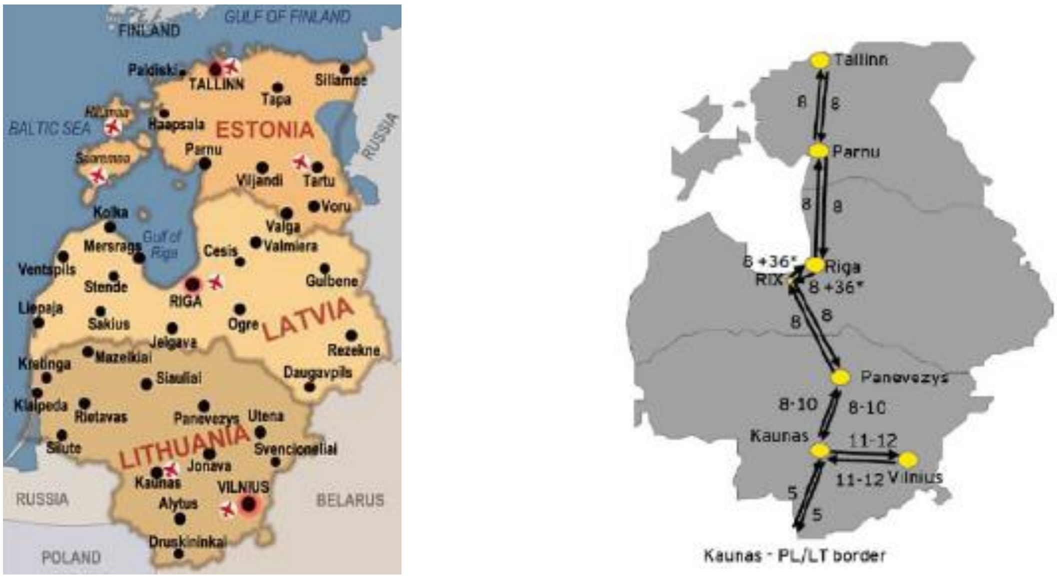


Illustration 50. General overview of airport location and railway connections.

Tallinn airport

Tallinn Airport is the largest airport in Estonia and is open to both domestic and international flights. It is located 5.0 km south-east of the center of Tallinn on the eastern shore of Lake Ülemiste. It was formerly known as Ülemiste Airport. Tallinn International Airport is currently accommodating about 16 airline companies with more than 35 international destinations.

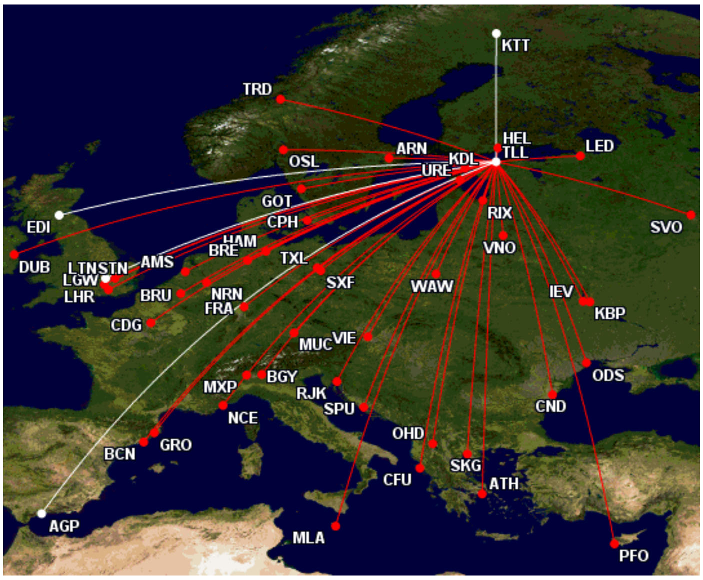


Illustration 51. Flight destinations from Tallinn airport

Tallinn Airport passenger traffic was about 3 million passengers in year 2018 and no transit or transfer or passengers is accounted. Direct flight services to and from Vilnius and Riga are also offered.

Riga International airport (RIX)

Riga International Airport is currently accommodating about 17 airlines companies with more than 80 international destinations (100 during the summer time).

Illustration 52. Flight destinations from Riga airport

Riga airport traffic is showing a regular and significant growth for the last 15 years reaching a volume of about 7 million of passengers in 2018[18].

18 http://www.riga-airport.com/uploads/files/Partneriem/aviacija/statistika/2019/1_RIX_Statistics%202019_JAN.pdf

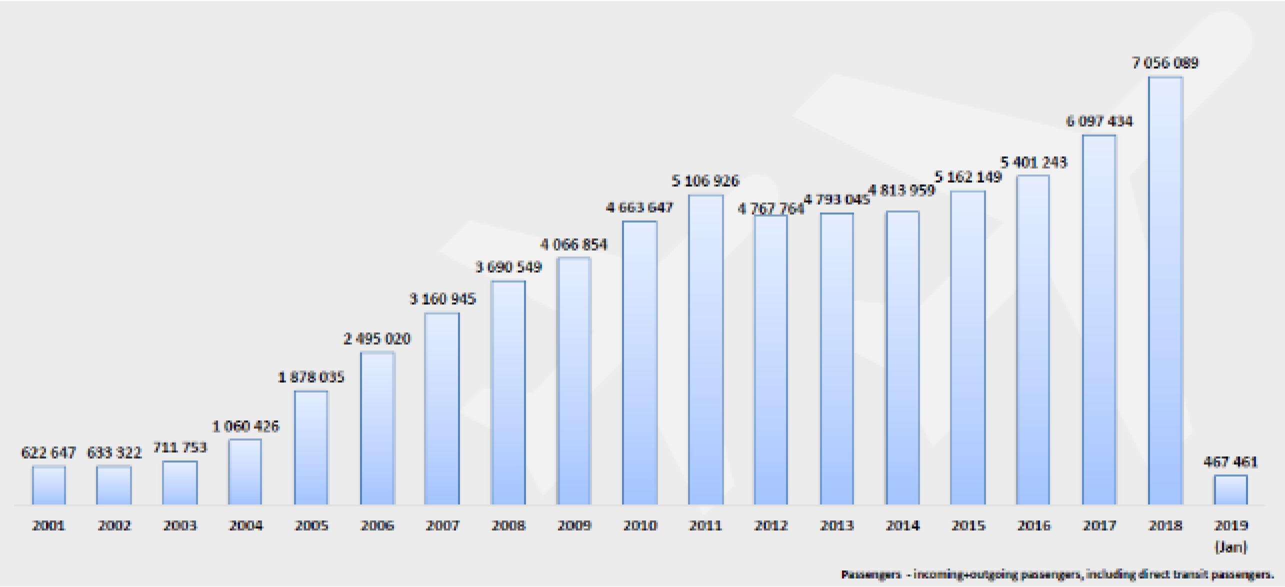


Illustration 53. Riga Airport (RIX) passenger traffic

With the following transfer and transit breakdown. According to Riga airport statistics, about 28% of the passengers are travelling through Riga airport in transfer or transit. So, in simple words, it means that only 72% of the total airport passenger traffic (5 million) shall be considered.

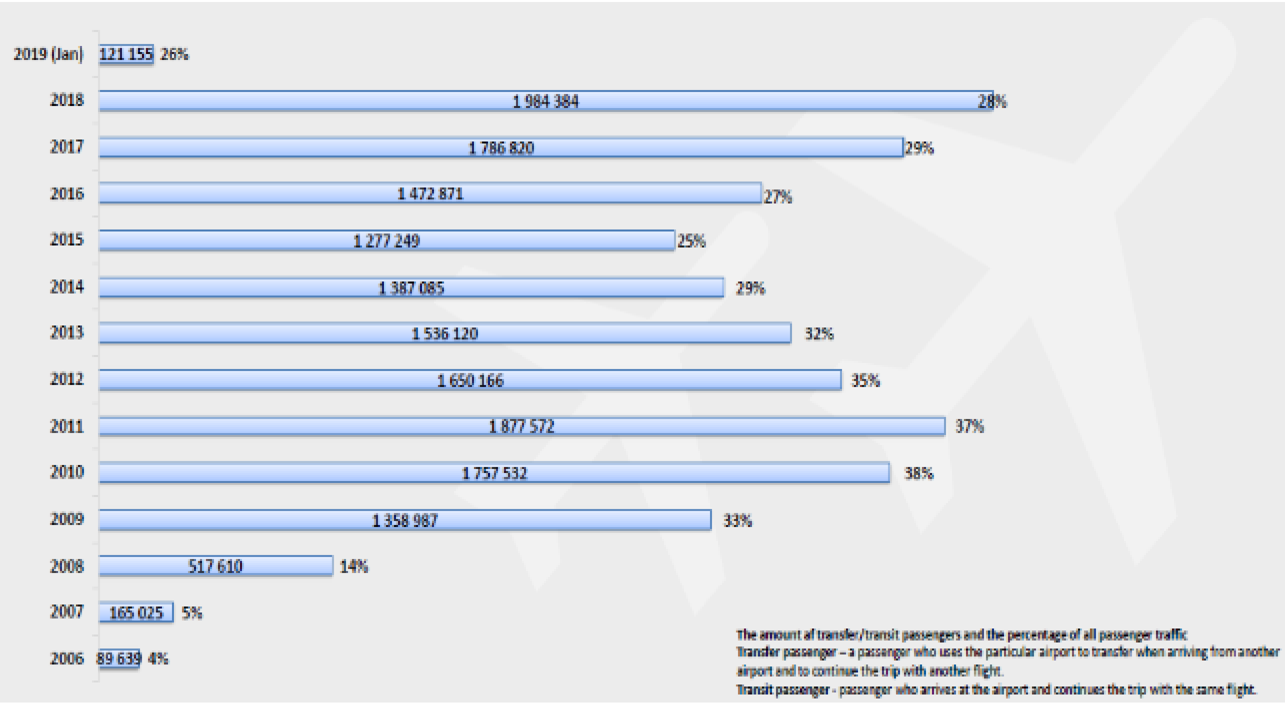


Illustration 54. Transfer / transit breakdown at Riga International airport

With the following breakdown of destinations:

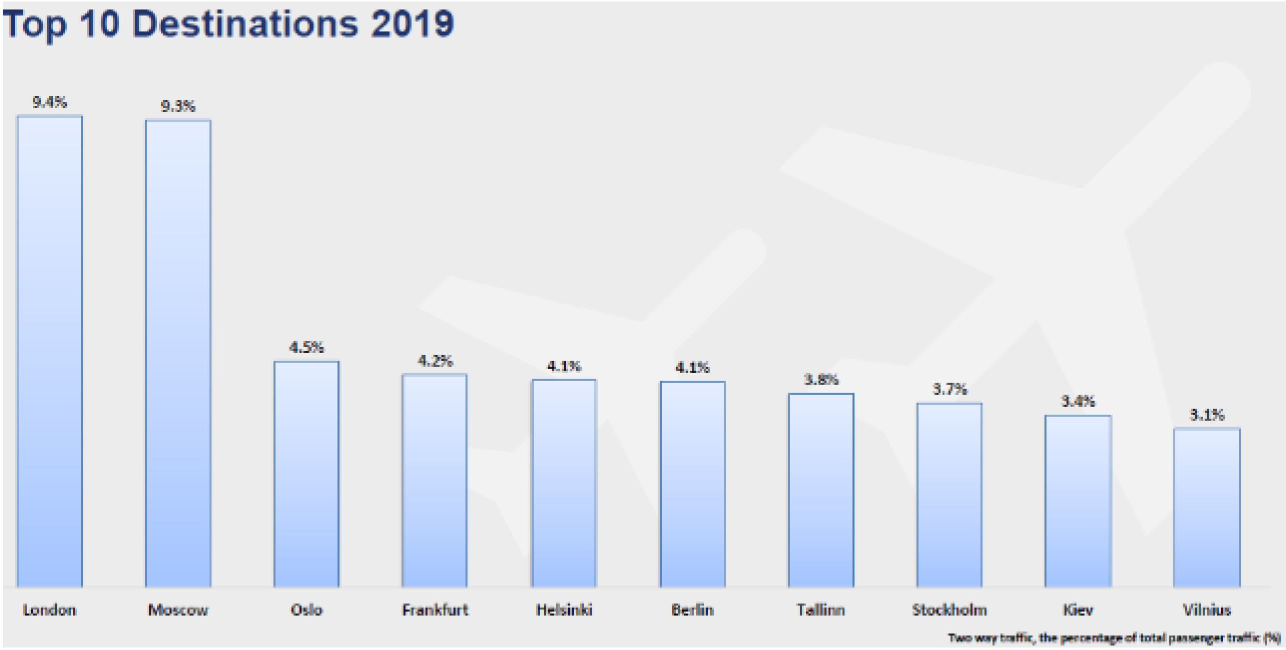


Illustration 55. Most popular destinations (top 10)

London and Moscow are the most popular destinations from Riga Airport. It is observed also that Tallinn and Vilnius Cities represent respectively 3,8 and 3,1 % of the traffic (6,9 % in total) which is a negligible part of the traffic.

Vilnius airport

Vilnius Airport is the international airport of Vilnius, the capital of Lithuania. It is located 5,9 km south of the city. It is the largest of the four commercial airports in Lithuania by passenger traffic, with more than 4.9 million passengers in year 2018. Vilnius saw a large increase with 17% more than the previous year. According to Vilnius airport statistics, transfer and transit of passenger is very low, in the range of 0.05%[19].

19 https://www.vilnius-airport.lt/upload/uf/847/84734affbe7b998b33b583cfc650fb7e.pdf

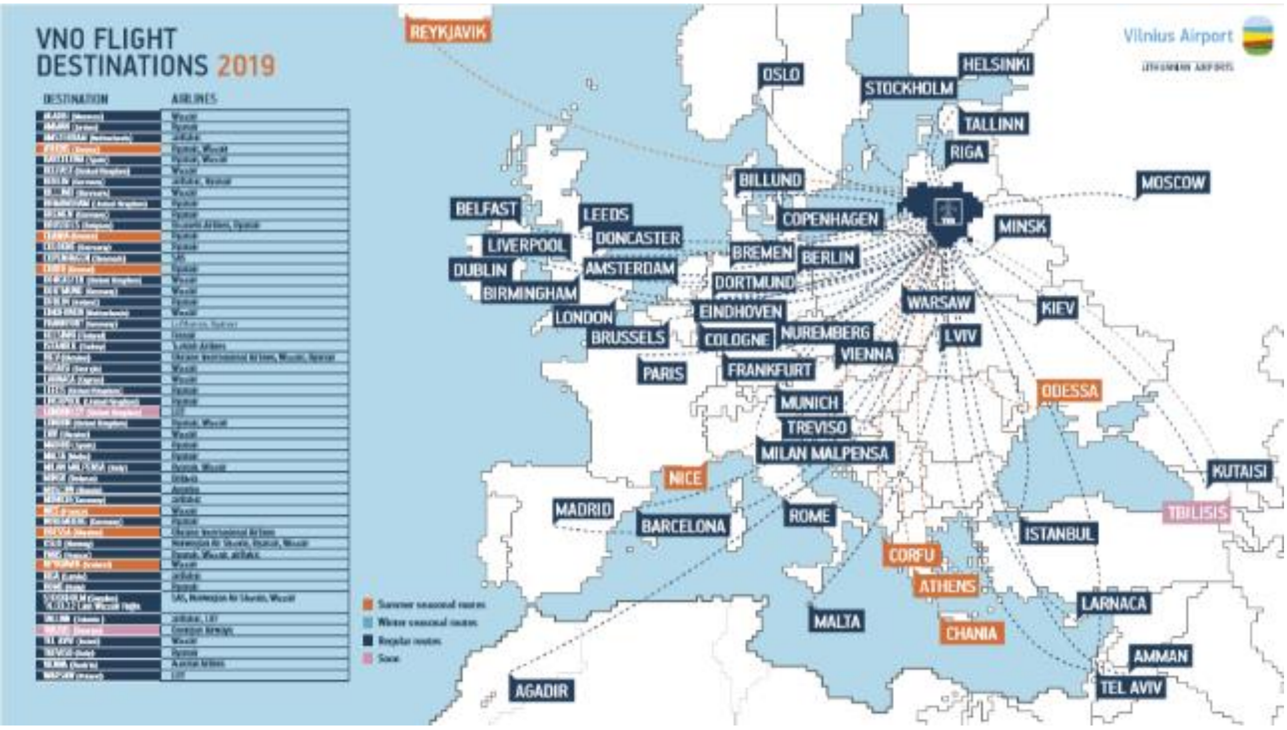


Illustration 56. Flight destinations from Vilnius airport

Vilnius International Airport serves as a base for about 20 airlines companies and is offering between 40 and 50 different flight destinations according to seasonal demands. Direct flights with Tallinn and Vilnius are also proposed.

Kaunas airport

Kaunas International Airport is the second-busiest civil airport in Lithuania after Vilnius Airport and the fourth-busiest in the Baltic states. The airport is located in the central part of the country, 14 km northeast of the Kaunas city centre and 100 km west from the capital Vilnius.

Kaunas passenger traffic for year 2018 was about 1 million and is offering between 15 and 23 destinations accommodated by 2 low cost airlines (Ryanair and Wizzair) and one charter. No direct flights to other Baltic country destinations from / to this airport are offered. There is no passenger in transit or transfer in Kaunas airport.

Currently there is no direct connection by railway but only by bus.

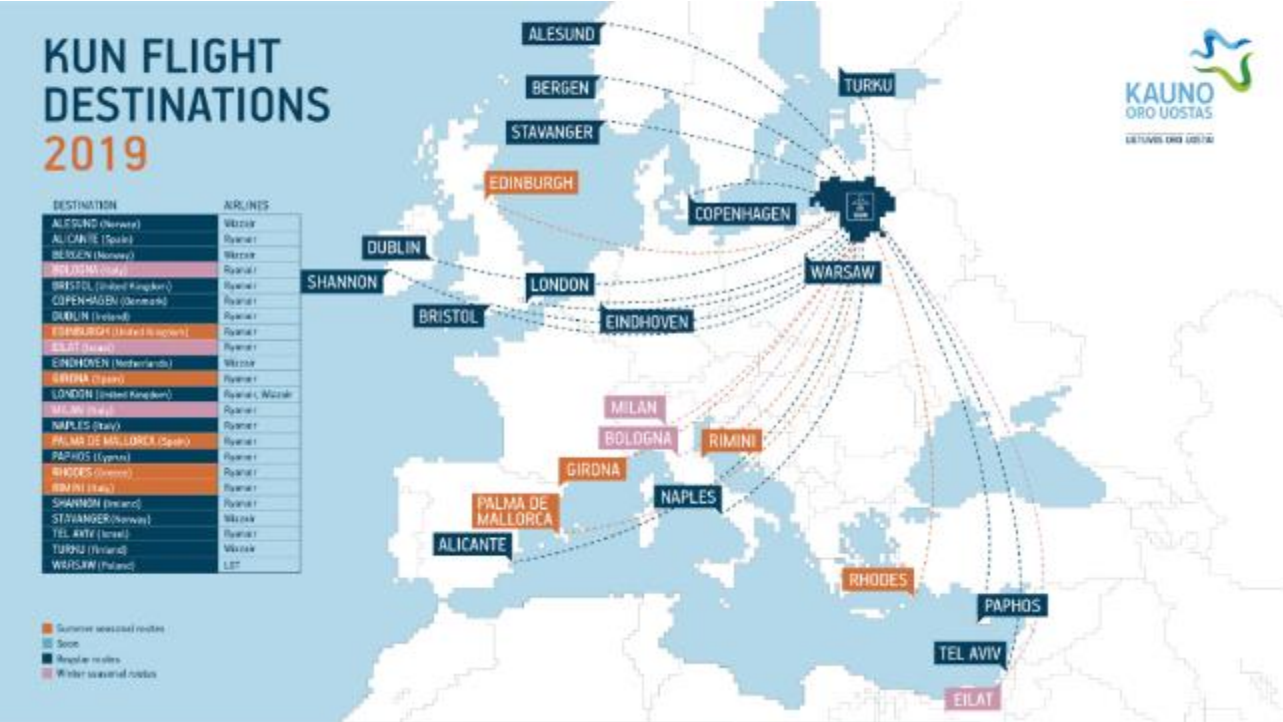


Illustration 57. Flight destination from Kaunas airport

Baltic Airports, performance comparison

Airport	Traffic (excluding transfer and transit), pass.million year 2018	Number of destinations	Number of airline companies	Comments
Tallinn airport	3,0 million	35	16	Compared to Riga and Vilnius airports, activity levels are lower although the airport is planning for significant growth. Also Tallinn is at the end section of RB network which will re-enforce its position in this area.
Riga airport (RIX)	5,0 million	80 to 100	17	Riga is the hub of Air Baltic airline companies and is also offering transit or transfer opportunities to Vilnius and Tallinn.
Vilnius airport	4,9 million	40 to 50	20	Taking into account passenger volumes, significant activities
Kaunas airport	1 million	15 to 23	2 or 3 (low-cost)	Can be considered as a complementary airport of Vilnius for "low-cost" airlines companies.

Table 14. **Performances of Baltic airports in year 2018**

Among all 4 airports, Riga international airport is the biggest one in terms of passenger volumes and number of destinations. Vilnius airport is ranking second with a choice of fewer destinations compared to Riga airport (but accommodating more companies). Tallinn is the third one in the same class of international airport with fewer passengers than Riga and Vilnius. Kaunas airport offer specific and typical “low-cost” market segment services.

Railway operation services

Passenger operation plan patterns proposed in the Operation Plan is the following. All passenger included in the scope of this feasibility study will be served by HST and Regional trains.

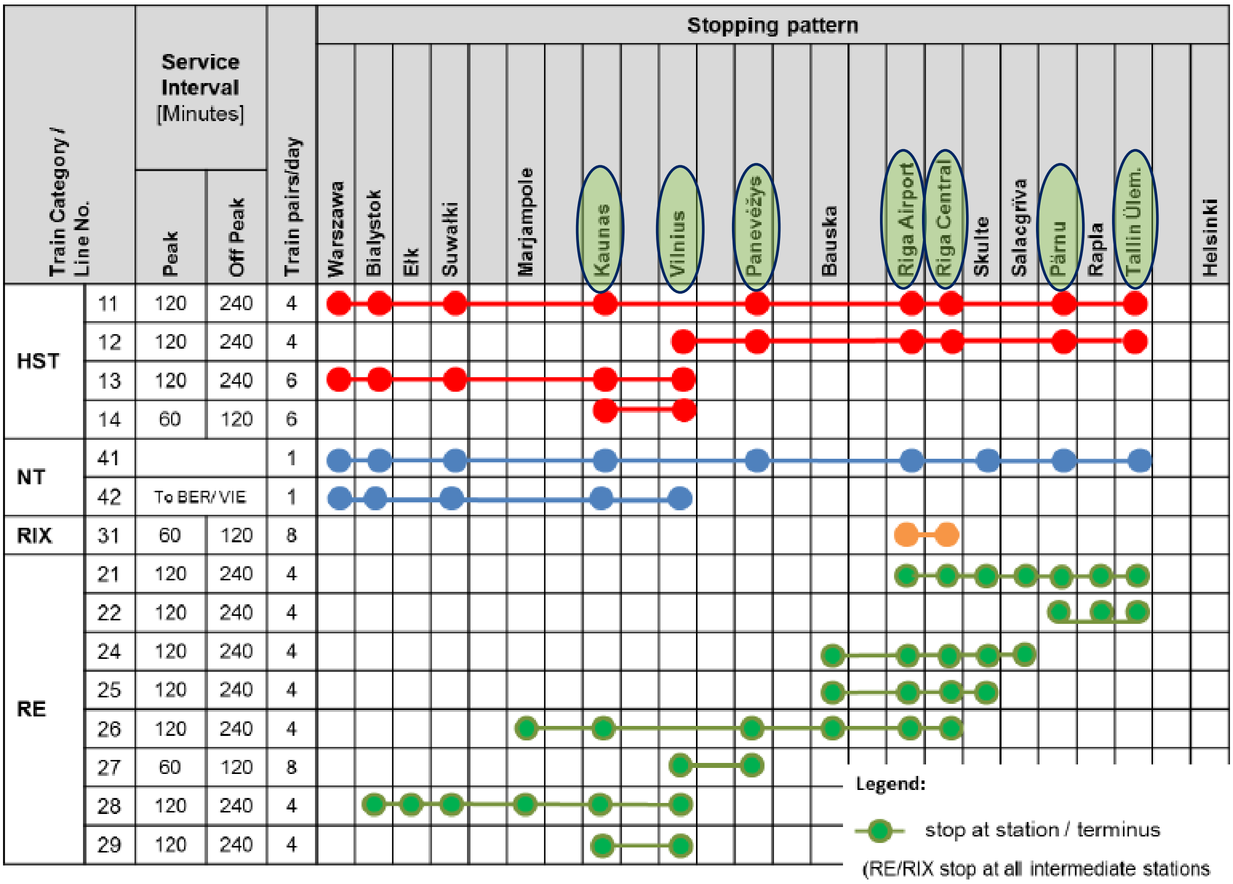


Illustration 58. Passenger train service pattern in 2026

In general, there are four types of passenger trains in the passenger train pattern:

- High-Speed Trains (HST) with a maximum speed of 249 km/h52 and few stops to realize a high travel speed.
- Night Trains (NT) for long-distance international overnight services with few stops (Vmax = 200 km/h) and arrival in the final destination in the early morning.

- Regional Express (RE) trains to connect regional centers with additional stops along the alignment (Vmax =160/200 km/h53).
- RIX shuttle trains between Riga Central and Riga Airport (Vmax = 160/200 km/h). HEL shuttles between Tallinn and Helsinki are not included.

Only High-Speed trains, and RIX shuttle trains will be considered as offering rail-airport integrated services.

In regional traffic all services have been developed in an integrated way. This means that RIX shuttles are not considered as a separate service in fact they are integrated in the entire time table and passengers can either go by a RE or RIX in Riga metropolitan area.

Usage forecasts

Existing traffic forecast data

Unfortunately, the existing studies are not providing accurate data regarding the future railway – flight passenger forecasts. Only basic assumptions (from E & Y study) are expressed more for the identification of diversion of air traffic to Rail Baltica or the transport modal share, between road, RB, air than to identify for the different time horizon what will be the number of passengers using RB railway solution from / to airport destinations.

New information regarding air traffic has therefore been collected from EuroStat as shown in Table 1. Be aware the figures in Table 1 are two-way traffic, because of that OD combinations between Baltic Airports in the two directions should not be added. Figures not available (e.g. to and from Kaunas) is because of no regular traffic between the OD combinations.

Consolidated demand forecast for long distance traffic (WP1.3 of the Operational Plan Concept for Rail Baltica railway, ETC Gauff Mobility, 2018) shows the following passenger forecasts for daily long-distance passenger traffic to justify the proposed train service in the Operational Plan.

1000 passenger trips (Source: Consultants estimate based on the CBA)

	Tallinn-Parnu	Parnu-Riga	Riga-RIX	RIX-Panevezys	Panevezys Kaunas	Kaunas-Vilnius	Kaunas-Poland
2026	407	337	756	373	648	845	341
2036	1098	906	2111	966	1662	2159	870
2046	1187	980	2375	1014	1729	2240	904
2056	1272	1052	2656	1061	1794	2316	933

Table 15. **Long-distance passenger trips per day (AADT Annual Average Daily Traffic, both directions) without FinEst tunnel**

Consolidated demand forecast for regional passenger traffic (WP 1.3 WP1.3 of the Operational Plan Concept for Rail Baltica railway, ETC Gauff Mobility, 2018) shows different sets of tables regarding traffic forecast for regional passenger services but in the Operational Plan Concept for Rail Baltica railway, trip generation and trip loads are only indicative because the earlier Rail Baltica studies do not address regional traffic and do not provide a basis for consolidation. The uncertainties are especially high for local traffic in and around Riga, Kaunas and Vilnius because of considerable other public transport offers as well as the overall train offer and pricing on Rail Baltica.

In some extent, despite that rail-airport passengers should mainly travel with long-distance passenger trains, regional trains will be also a possible mean of transport to reach the airport as well.

It is also observed that the stations to be considered within the scope of this feasibility are limited to Tallinn, Pärnu, Riga, Riga Airport, Panevėžys, Kaunas and Vilnius which are for all of them either long distance trains (HST) or Regional (RE) ones

Typically, regional traffic forecasts are presented as follows:

Section		2026	2036	2046	2056
Tallinn	Assaku	900	2,100	2,250	2,400
Assaku	Luige	750	1,650	1,800	1,800
Luige	Saku	450	1,200	1,350	1,350
Saku	Kurtna	450	1,050	1,050	1,200
Kurtna	Kohila	450	1,050	1,050	1,050
Kohila	Rapla	300	750	900	900
Rapla	Järvakandi	300	600	600	600
Järvakandi	Kaisma	150	450	450	450
Kaisma	Tootsi	150	450	450	450
Tootsi	Kliksama	300	600	600	600
Kliksama	Pärnu	300	600	750	750

Table 16. **Indicative 2-way daily regional passengers on section Tallinn – Pämu (AAWDT)**

In the above example, in the last transport segment of the trip Tallinn – Pärnu, the closest to the airport of Tallinn (i.e. Tallinn - Assaku), the indicative 2-way daily regional passengers (AAWDT) is 900 in year 2026. Among these 900 passengers, it shall be taken as assumption that some of them using regional passenger services, are travelling from / to Tallinn airport (in a proportion unknown at this stage of RB project development). These volumes could be added to the long-distance passenger trains (1 115 year 2026) of Tallinn – Pärnu (refer to the previous table) when they will be made more robust in next stages of development of RB studies.

Methodology implemented by the Consultant

There is no specific data or assumptions expressed in previous studies regarding the proportion of passengers who will use RB combining rail and air transport means, no specific results of state preference surveys existing.

Passenger forecasts, in the context of this feasibility study shall focus on:

- Among the total rail passenger volumes, which part will combine rail & flight transport solutions?
- From the above passenger volume combining rail & flight solution, which part will be attracted by rail-airport integrated services?

From the pure "state-of the art" approach, forecasting air passenger usage of airport rail links requires an understanding of the geographic origins and destinations and the market segmentation of passengers. These characteristics give rise to different propensities to use various modes of transport which can be modelled against variables such as travel time, fare and other factors. Once these are determined for each zone and segment, they can be added to give a total forecast. As with any forecast, the assumptions are critical and should be tested, not least be checked against actual usage at similar situations.

Passenger forecasts lead to revenue forecast which can then be used in looking at the financial situation of a proposal or to test various fare levels. Daily, weekly and seasonal flows on airport rail links will be different from other rail users.

Due to the lack of accurate information on the rail-airport origin-destination and passenger volumes a pragmatic approach has been implemented by the Consultant: general data from IARO can be used to assess rail & flight passengers volumes according to international benchmarks[20] including around 200 airports with rail links in the world.

The IARO is a world-wide organization dedicated to spreading world-class best practice and good workable ideas among people interested in rail links to airports and air-rail inter-modality. Its world-wide membership includes organizations planning, developing, building and operating rail air links - and airlines who have a business interest in partnerships for their success.

A specific care should be taken as rail shares vary from a few percent to over 50 per cent. Examples of mode shares achieved by various airport rail links are shown in the following figure. There are some surprises in these figures, for example small airports do not necessarily have small rail shares, airports with dedicated rail links do not necessarily have large rail shares and airports with a number of rail services do not necessarily have a higher rail share.

It is nevertheless clear that North American airports generally have lower rail shares than European or Asia airports.

In the most pessimist case, the mode shares achieved by various airport rail links is in the range of 15 %

20 https://www.iaro.com/sitefiles/IARO%20Report%2018.13.pdf

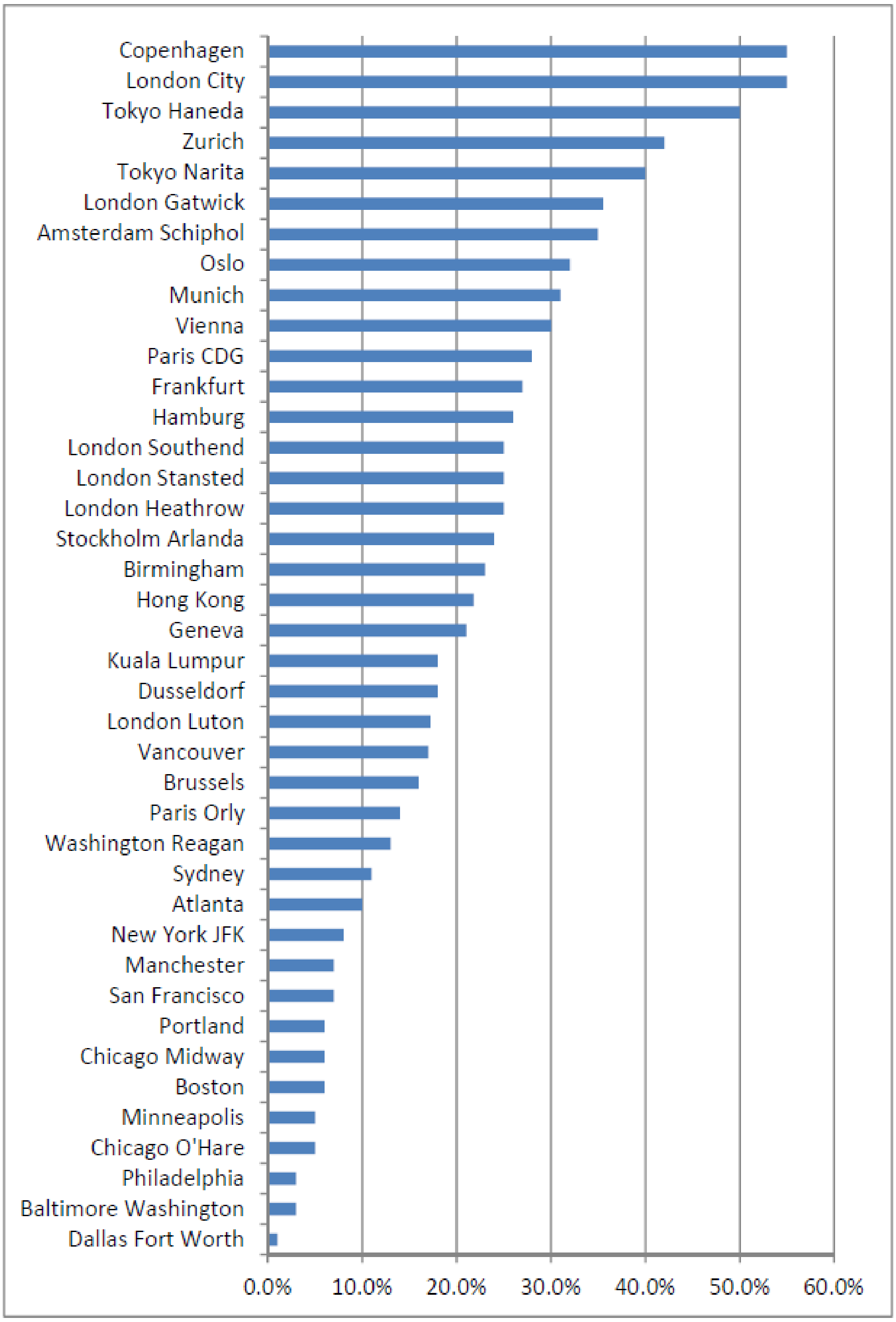


Illustration 59. Transport modal share for airport rail links (IARO statistics)

In complement to the above IARO statistics, GARA experience can also be used21.(GARA Airport Express 2016 Booklet). It provides more detailed figures regarding rail air-flight modal share where it could be possible to identify if "common rules" are existing guiding the modal share.

21 https://www.globalairrail.com/about-us/publications

City or airport	Oslo	Arlanda	Stansted	Hong Kong	Gatwick	Sidney	Moscow	Johannesburg	Kuala Lumpur	Rome	Heathrow	Vienna	Brisbane's airtrain
Number of stops	9 stops	Non-stop	2 stops	5 stops	Non-stop	10 stops	Non-stop	4 stops	Non-stop	Non-stop	Non-stop	Non-stop	7 stops
Pass. Million	6,6	3,5	5	15,73	5,8	7,03	12,963	1,8	11	3,7	5,9	1,4	1,8
Modal share by rail	31,80%	29%	25%	21,50%	20%	19%	17%	15%	15%	13%	9,23%	8,50%	7%
Trip length	50	39	56	35,3	43	9	31,5	80	59	31	26	19	15,9
Trip time (mn)	19	20	47	24	30	17,5	35	15	30	32	17,5	16	23
Commercial speed	157,89	117,00	71,49	88,25	86,00	30,86	54,00	320,00	118,00	58,13	89,14	71,25	41,48
Price (U$D)	20,79	32,48	27,32	12,87	28,81	15	7,77	11,47	13	15,98	31,68	9,46	12,61
Price per km	0,42	0,83	0,49	0,36	0,67	1,67	0,25	0,14	0,22	0,52	1,22	0,50	0,79
Check in possibility	Yes but no for Luggage	Yes but no for Luggage	No	Yes full	No	No	No	No	Yes full	No	No	Yes but no for Luggage	No

Table 17. **GARA statistics**

- In orange cells: modal share above 20 % (high)
- In green cells: modal share between 10 and 20 % (medium)
- In blue cells: modal share inferior to 10 % (low)

Unfortunately, the analysis of the above tables does not show obvious "common rules" to assess and to identify why some rail and flight services are performant with high modal share and some other less performant.

It quite sure that each airport is a specific business case, and some external elements, not reflected in the above table, shall be considered.

Typically, for shuttle express train services, to have secured arrival time at airport if the city is facing traffic jams shall be considered. As example, before Aeroexpress services was implemented in Moscow, travel trip by private cars or taxi was between 40mn to 2 hours and is now secured to 35mn by train.

Some "driving forces" are existing that influence the key decision factor of passengers. Many different factors influencing the costs of the service shall also be identified. Some of the factors have a significant impact on the costs, others are less important. Below, a list of driving forces is presented. In the following step, these forces shall be ranked based on their importance and uncertainty:

- Number of passengers using rail & flight transport solution (traffic forecasts);
- Geographical distribution of passengers using the service, dispersion of passengers over a region
- Variation in weight and size of baggage passengers check in;
- Fuel prices, competitive other transport mode;
- Congestion on the road network;
- Price, cost.

So, for RB case, only assumptions can be expressed at this stage, to be confirmed by business development studies supported by preference state surveys.

Rail & flight-air passenger traffic forecasts

As preamble, it is pointed out that not accurate surveys regarding rail & flight passengers are existing yet and the introduction of RB railway services will more than likely change the current passenger trip organization and solutions: passengers will travel to one specific airport more accordingly to the destination of flights proposed by each airport of course if this airline destination could be reached by a direct flight and interesting price (train + flight). Therefore, passengers will not always to the nearest airport, but of the most convenient and interesting one for their total trip.

Passenger trip volumes are forecasted for year 2026, considering as assumption the regular and current passenger increase trends observed for the last 6 years and forecasts of airport for the next 10 years

Consultant's assumptions to set-up rail & flight modal share are the following:

Tallinn, Pärnu, Riga, Riga Airport, Panevėžys, Kaunas and Vilnius

- Riga central - Riga airport, Riga Airport - Panevėžys considered to be in the range of 25 %, due to air hub typology of Riga airport and shuttle typology;
- Tallinn - Pärnu, Kaunas – Vilnius considered to be in the range of 15 % (medium level), terminal stations of RB network;
- Panevėžys - Kaunas, considered to be in the range of 10 % (low level), low cost airline passenger user should not be so attracted to pay additional fees for rail-airport integrated services;
- Other trips as Pärnu – Riga, Kaunas - Poland in the range of 5 % only.

The rail & flight modal share is allocated taking into account the possible rank of each airport compared to IARO benchmark.

Airport	Passenger trips volumes, year 2018 (trip million)	Passenger trip increase per year (6 years)	Passenger trips volumes, year 2026 (trip million)	Rail & flight modal share (%)	Passenger rail & flight combined trips
Tallinn airport	3	10,00%	4,8	15,00%	720 000
Riga airport (RIX)	5	8,00%	7,4	25,00%	1 850 000
Vilnius airport	4,9	10,00%	7,84	15,00%	1 176 000
Kaunas airport	1	20,00%	2,2	10,00%	220 000
TOTAL	13,9		22,24		3 966 000

Table 18. **Performances of Baltic airports in year 2026 - rail & flight modal share (IARO benchmark)**

Compared to the consolidated demand forecast for long distance traffic of the Operational Plan Concept for Rail Baltica railway[22], ETC Gauff Mobility, 2018) expressed annually, in general, almost 35% of RB long distance passengers should be rail & flight trip passengers. Consolidated demand forecast for long distance traffic of the Operational Plan Concept is the following:

Year	Tallinn - Pärnu	Pärnu - Riga	Riga Central - Riga airport RIX	Riga airport RIX - Panevėžys	Panevėžys - Kaunas	Kaunas - Vinius	Kaunas Poland
2026	407 000	337 000	756 000	373 000	648 000	845 000	341 000
2036	1 098 000	906 000	2 111 000	966 000	1 662 000	2 159 000	870 000
2046	1 187 000	980 000	2 375 000	1 014 000	1 729 000	2 240 000	904 000
2056	1 272 000	1 052 000	2 656 000	1 061 000	1 794 000	2 316 000	933 000

Table 19. **Long distance passenger trips (operation plan)[23]**

[22] the Operational Plan Concept for Rail Baltica railway, ETC Gauff Mobility, 2018)
[23] Note this is passenger trips, not number of passengers

This the assumption of 35 % of rail & flight trip passengers of the total passenger volume is considered by the Consultant to be over-optimistic compared to the IARO benchmark (previous table and illustration 59) and is more related to shuttle railway airport services

This figure is rather optimistic but mainly explainable by the current trend of increase of Baltic airport passenger volumes. In a more pragmatic way, at least the following assumptions, based on the respective modal transport share rail-airport trip of each airport, can be expressed for each railway station. Each railway station is cumulating all passenger trains for each individual RB rail section forecast.

Rail-airport integrated service traffic forecasts

An interesting study case [24] example can also be used as a reference for Schiphol airport in Amsterdam, year 2008 where 3 different scenarios, a pessimistic scenario (5%), a medium or baseline scenario (15%) and an optimistic scenario (25%).

According to this study, the different scenarios are showing different results which could be similar for RB case:

Pessimistic Scenario: Disappointing Numbers. The full rail-airport integrated service has been introduced, but has not turned out to be the success RB had hoped for. Though the rate of mishandled baggage has not increased with the luggage collection service, passengers appear to be reluctant to use the service. Perhaps the passengers do not see the advantages of the service or they are not willing to pay for the additional service. Especially passengers travelling for business purposes try not to bring along hold baggage and therefore do not need to use the service. The problems are similar throughout the country; in all 3 countries the interest in the service is below expectations. Only five percent of all departing passengers flying use the Baggage Collection Service.

Medium or baseline scenario: Foreseen Results. The introduction of the full rail-airport integrated service has been a success. Many passengers have used the service, and most of them are satisfied. Mishandled baggage rates have gone down and passengers have experienced the advantages of the service. However, competitors have witnessed the success of the service and currently, many similar services are being offered. The growth of the service has come to a halt and the installations in railway stations are still not fully utilized. However, fifteen percent of all rail & flight passengers use the service, which has been the aim from the start.

Optimistic scenario: Unexpected Successes. The full rail-airport integrated service has been a success from the start. Perhaps due to the economic growth, perhaps due to the marketing efforts of RB and airlines, but the success of the service has exceeded all expectations. Passengers are extremely satisfied with the service and within the first

24 https://repository.tudelft.nl/islandora/object/uuid.../download

year, approximately 25 percent of all departing passengers use the service. Though some competitors have tried to start similar service concepts, none of them has succeeded.

Rail-airport integrated services - traffic forecasts in stations

Same assumptions are also taken for the different time horizons for the concerned stations of RB projects in the following tables:

RB railway section:	Tallinn - Pärnu		Pärnu - Riga		Riga Central - Riga airport RIX		Riga airport RIX - Panevėžys		Panevėžys - Kaunas		Kaunas - Vinius		Kaunas - Poland	
Passenger volume year 2026 on the railway section	**407 000**		**337 000**		**756 000**		**373 000**		**648 000**		**845 000**		**341 000**	
Station	Tallinn	Pärnu	Pärnu	Riga central	Riga central	Riga RIX	Riga RIX	Panevėžys	Panevėžys	Kaunas	Kaunas	Vinius	Kaunas	Poland
Passenger volume in each station	407 000	407 000	337 000	337 000	756 000	756 000	373 000	373 000	648 000	648 000	845 000	845 000	341 000	341 000
% or rail-air passenger considered	15,00%	15,00%	5,00%	5,00%	25,00%	25,00%	25,00%	25,00%	10,00%	10,00%	15,00%	15,00%	5,00%	5,00%
Total both flows per station	61 050	61 050	16 850	16 850	189 000	189 000	93 250	93 250	64 800	64 800	126 750	126 750	17 050	17 050
Rail-air passengers	61 050	77 900		205 850		282 250		158 050		191 550		126 750	17 050	17 050
Scenario rail-airport integrated services (passenger trip volumes):														
Scenario pessimistic 5 % , per year	3 053	3 895		10 293		14 113		7 903		9 578		6 338	853	853
Scenario medium 15 %, per year	9 158	11 685		30 878		42 338		23 708		28 733		19 013	2 558	2 558
Scenario optimistic 25 %, per year	15 263	19 475		51 463		70 563		39 513		47 888		31 688	4 263	4 263
Scenario pessimistic 5 % , per day	8	11		28		39		22		26		17	2	2
Scenario medium 15 %, per day	25	32		85		116		65		79		52	7	7
Scenario optimistic 25 %, per day	42	53		141		193		108		131		87	12	12

Table 20. **Rail & flight- passenger traffic using rail-airport integrated services in stations (2026)**

RB railway section:	Tallinn - Pärnu		Pärnu - Riga		Riga Central - Riga airport RIX		Riga airport RIX - Panevėžys		Panevėžys - Kaunas		Kaunas - Vinius		Kaunas - Poland	
Passenger volume year 2036 on the railway section	**1 098 000**		**906 000**		**2 111 000**		**966 000**		**1 662 000**		**2 159 000**		**870 000**	
Station	Tallinn	Pärnu	Pärnu	Riga central	Riga central	Riga RIX	Riga RIX	Panevėžys	Panevėžys	Kaunas	Kaunas	Vinius	Kaunas	Poland
Passenger volume in each station	1 098 000	1 098 000	906 000	906 000	2 111 000	2 111 000	966 000	966 000	1 662 000	1 662 000	2 159 000	2 159 000	870 000	870 000
% or rail-air passenger considered	15,00%	15,00%	5,00%	5,00%	25,00%	25,00%	25,00%	25,00%	10,00%	10,00%	15,00%	15,00%	5,00%	5,00%
Total both flows per station	164 700	164 700	45 300	45 300	527 750	527 750	241 500	241 500	166 200	166 200	323 850	323 850	43 500	43 500
Rail-air passengers	164 700	210 000		573 050		769 250		407 700		490 050		323 850	43 500	43 500
Scenario rail-airport integrated services (passenger trip volumes):														
Scenario pessimistic 5 % , per year	8 235	10 500		28 653		38 463		20 385		24 503		16 193	2 175	2 175
Scenario medium 15 %, per year	24 705	31 500		85 958		115 388		61 155		73 508		48 578	6 525	6 525
Scenario optimistic 25 %, per year	41 175	52 500		143 263		192 313		101 925		122 513		80 963	10 875	10 875
Scenario pessimistic 5 % , per day	23	29		79		105		56		67		44	6	6
Scenario medium 15 %, per day	68	86		236		316		168		201		133	18	18
Scenario optimistic 25 %, per day	113	144		393		527		279		336		222	30	30

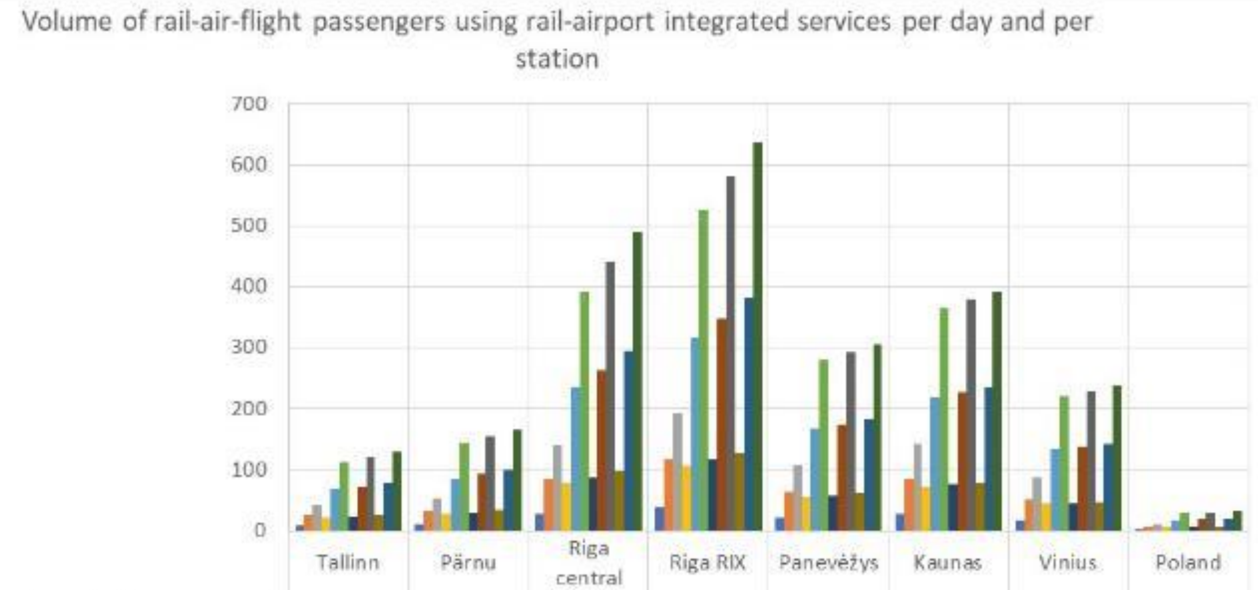
Table 21. **Rail & flight passenger traffic using rail-airport integrated services in stations (2036)**

RB railway section:	Tallinn - Pärnu		Pärnu - Riga		Riga Central - Riga airport RIX		Riga airport RIX - Panevėžys		Panevėžys - Kaunas		Kaunas - Vinius		Kaunas - Poland	
Passenger volume year 2046 on the railway section	**1 187 000**		**980 000**		**2 375 000**		**1 014 000**		**1 729 000**		**2 240 000**		**904 000**	
Station	Tallinn	Pärnu	Pärnu	Riga central	Riga central	Riga RIX	Riga RIX	Panevėžys	Panevėžys	Kaunas	Kaunas	Vinius	Kaunas	Poland
Passenger volume in each station	1 187 000	1 187 000	980 000	980 000	2 375 000	2 375 000	1 014 000	1 014 000	1 729 000	1 729 000	2 240 000	2 240 000	904 000	904 000
% or rail-air passenger considered	15,00%	15,00%	5,00%	5,00%	25,00%	25,00%	25,00%	25,00%	10,00%	10,00%	15,00%	15,00%	5,00%	5,00%
Total both flows per station	178 050	178 050	49 000	49 000	593 750	593 750	253 500	253 500	172 900	172 900	336 000	336 000	45 200	45 200
Rail-air passengers	178 050	227 050		642 750		847 250		426 400		508 900		336 000	45 200	45 200
Scenario rail-airport integrated services (passenger trip volumes):														
Scenario pessimistic 5 % , per year	8 903	11 353		32 138		42 363		21 320		25 445		16 800	2 260	2 260
Scenario medium 15 %, per year	26 708	34 058		96 413		127 088		63 960		76 335		50 400	6 780	6 780
Scenario optimistic 25 %, per year	44 513	56 763		160 688		211 813		106 600		127 225		84 000	11 300	11 300
Scenario pessimistic 5 % , per day	24	31		88		116		58		70		46	6	6
Scenario medium 15 %, per day	73	93		264		348		175		209		138	19	19
Scenario optimistic 25 %, per day	122	156		440		580		292		349		230	31	31

Table 22. **Rail & flight passenger traffic using rail-airport integrated services in stations (2046)**

RB railway section:	Tallinn - Pärnu		Pärnu - Riga		Riga Central - Riga airport RIX		Riga airport RIX - Panevėžys		Panevėžys - Kaunas		Kaunas - Vinius		Kaunas - Poland	
Passenger volume year 2056 on the railway section	**1 272 000**		**1 052 000**		**2 656 000**		**1 061 000**		**1 794 000**		**2 316 000**		**933 000**	
Station	Tallinn	Pärnu	Pärnu	Riga central	Riga central	Riga RIX	Riga RIX	Panevėžys	Panevėžys	Kaunas	Kaunas	Vinius	Kaunas	Poland
Passenger volume in each station	1 272 000	1 272 000	1 052 000	1 052 000	2 656 000	2 656 000	1 061 000	1 061 000	1 794 000	1 794 000	2 316 000	2 316 000	933 000	933 000
% or rail-air passenger considered	15,00%	15,00%	5,00%	5,00%	25,00%	25,00%	25,00%	25,00%	10,00%	10,00%	15,00%	15,00%	5,00%	5,00%
Total both flows per station	190 800	190 800	52 600	52 600	664 000	664 000	265 250	265 250	179 400	179 400	347 400	347 400	46 650	46 650
Rail-air passengers	190 800	243 400		716 600		929 250		444 650		526 800		347 400	46 650	46 650
Scenario rail-airport integrated services (passenger trip volumes):														
Scenario pessimistic 5 % , per year	9 540	12 170		35 830		46 463		22 233		26 340		17 370	2 333	2 333
Scenario medium 15 %, per year	28 620	36 510		107 490		139 388		66 698		79 020		52 110	6 998	6 998
Scenario optimistic 25 %, per year	47 700	60 850		179 150		232 313		111 163		131 700		86 850	11 663	11 663
Scenario pessimistic 5 % , per day	26	33		98		127		61		72		48	6	6
Scenario medium 15 %, per day	78	100		294		382		183		216		143	19	19
Scenario optimistic 25 %, per day	131	167		491		636		305		361		238	32	32

Table 23. **Rail & flight passenger traffic using rail-airport integrated services in stations (2056)**



	Tallinn	Pärnu	Riga central	Riga RIX	Panevėžys	Kaunas	Vinius	Poland
2026 Scenario pessimistic 5 % , per day	8	11	28	39	22	29	17	2
2026 Scenario medium 15 %, per day	25	32	85	116	65	86	52	7
2026 Scenario optimistic 25 %, per day	42	53	141	193	108	143	87	12
2036 Scenario pessimistic 5 % , per day	23	29	79	105	56	73	44	6
2036 Scenario medium 15 %, per day	68	86	236	316	168	219	133	18
2036 Scenario optimistic 25 %, per day	113	144	393	527	279	365	222	30
2046 Scenario pessimistic 5 % , per day	24	31	88	116	58	76	46	6
2046 Scenario medium 15 %, per day	73	93	264	348	175	228	138	19
2046 Scenario optimistic 25 %, per day	122	156	440	580	292	380	230	31
2056 Scenario pessimistic 5 % , per day	26	33	98	127	61	79	48	6
2056 Scenario medium 15 %, per day	78	100	294	382	183	236	143	19
2056 Scenario optimistic 25 %, per day	131	167	491	636	305	393	238	32

Illustration 60. Rail & flight passengers using rail-airport integrated services in the different stations for the different time horizons

In the most optimistic scenario, year 2056, it shows as example that 636 passengers per day will use rail-airport integrated services in Riga RIX station, 131 in Tallinn, 491 in Riga main station, etc.

Rail-airport integrated service traffic forecasts in trains

To calculate the average number of passengers using rail-airport integrated services by train, the above figures of daily passengers per Origin-Destination trips are divided by the number of HST trains planned for each line section (Operational Plan Concept for Rail Baltica railway, ETC Gauff Mobility, 2018).

RB railway section:	Tallinn - Pärnu	Pärnu - Riga	Riga Central - Riga airport RIX	Riga airport RIX - Panevėžys	Panevėžys - Kaunas	Kaunas - Vinius	Kaunas - Poland
Passenger volume year 2026 on the railway section	**407 000**	**337 000**	**756 000**	**373 000**	**648 000**	**845 000**	**341 000**
Scenario rail-airport integrated services (passenger trip volumes):							
Scenario pessimistic 5 % , per day	8	2	26	13	9	17	2
Scenario medium 15 %, per day	25	7	78	38	27	52	7
Scenario optimistic 25 %, per day	42	12	129	64	44	87	12
Number of trains per day (both direction)	16	16	16	16	8	24	12
Number of passenger per day per train	**Tallinn - Pärnu**	**Pärnu - Riga**	**Riga Central - Riga airport RIX**	**Riga airport RIX - Panevėžys**	**Panevėžys - Kaunas**	**Kaunas - Vinius**	**Kaunas - Poland**
Scenario pessimistic 5 % , per day	0,52	0,14	1,62	0,80	1,11	0,72	0,19
Scenario medium 15 %, per day	1,57	0,43	4,85	2,40	3,33	2,17	0,58
Scenario optimistic 25 %, per day	2,61	0,72	8,09	3,99	5,55	3,62	0,97

Table 24. Rail & flight passenger traffic and passengers using rail-airport integrated services in each train (2026)

RB railway section:	Tallinn - Pärnu	Pärnu - Riga	Riga Central - Riga airport RIX	Riga airport RIX - Panevėžys	Panevėžys - Kaunas	Kaunas - Vinius	Kaunas - Poland
Passenger volume year 2036 on the railway section	**1 098 000**	**906 000**	**2 111 000**	**966 000**	**1 662 000**	**2 159 000**	**870 000**
Scenario rail-airport integrated services (passenger trip volumes):							
Scenario pessimistic 5 % , per day	23	6	72	33	23	44	6
Scenario medium 15 %, per day	68	19	217	99	68	133	18
Scenario optimistic 25 %, per day	113	31	361	165	114	222	30
Number of trains per day (both direction)	24	24	24	24	12	32	8
Number of passenger per day per train	**Tallinn - Pärnu**	**Pärnu - Riga**	**Riga Central - Riga airport RIX**	**Riga airport RIX - Panevėžys**	**Panevėžys - Kaunas**	**Kaunas - Vinius**	**Kaunas - Poland**
Scenario pessimistic 5 % , per day	0,94	0,26	3,01	1,38	1,90	1,39	0,74
Scenario medium 15 %, per day	2,82	0,78	9,04	4,14	5,69	4,16	2,23
Scenario optimistic 25 %, per day	4,70	1,29	15,06	6,89	9,49	6,93	3,72

Table 25. Rail & flight passenger traffic and passengers using rail-airport integrated services in each train (2036)

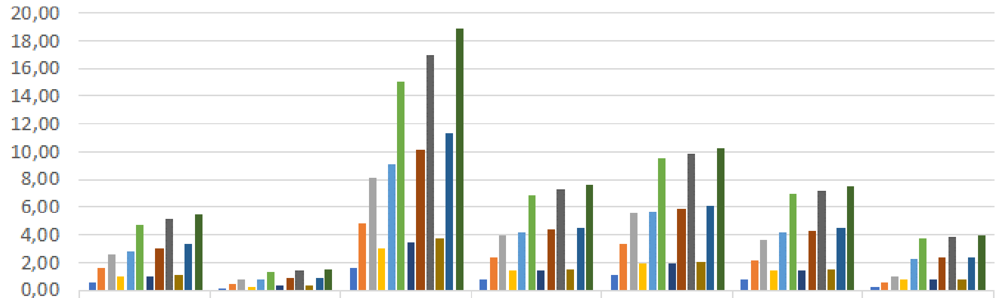
RB railway section:	Tallinn - Pärnu	Pärnu - Riga	Riga Central - Riga airport RIX	Riga airport RIX - Panevėžys	Panevėžys - Kaunas	Kaunas - Vinius	Kaunas - Poland
Passenger volume year 2046 on the railway section	**1 187 000**	**980 000**	**2 375 000**	**1 014 000**	**1 729 000**	**2 240 000**	**904 000**
Scenario rail-airport integrated services (passenger trip volumes):							
Scenario pessimistic 5 % , per day	24	7	81	35	24	46	6
Scenario medium 15 %, per day	73	20	244	104	71	138	19
Scenario optimistic 25 %, per day	122	34	407	174	118	230	31
Number of trains per day (both direction)	24	24	24	24	12	32	8
Number of passenger per day per train	**Tallinn - Pärnu**	**Pärnu - Riga**	**Riga Central - Riga airport RIX**	**Riga airport RIX - Panevėžys**	**Panevėžys - Kaunas**	**Kaunas - Vinius**	**Kaunas - Poland**
Scenario pessimistic 5 % , per day	1,02	0,28	3,39	1,45	1,97	1,44	0,77
Scenario medium 15 %, per day	3,05	0,84	10,17	4,34	5,92	4,32	2,32
Scenario optimistic 25 %, per day	5,08	1,40	16,94	7,23	9,87	7,19	3,87

Table 26. **Rail & flight passenger traffic and passengers using rail-airport integrated services in each train (2046)**

RB railway section:	Tallinn - Pärnu	Pärnu - Riga	Riga Central - Riga airport RIX	Riga airport RIX - Panevėžys	Panevėžys - Kaunas	Kaunas - Vinius	Kaunas - Poland
Passenger volume year 2056 on the railway section	**1 272 000**	**1 052 000**	**2 656 000**	**1 061 000**	**1 794 000**	**2 316 000**	**933 000**
Scenario rail-airport integrated services (passenger trip volumes):							
Scenario pessimistic 5 % , per day	26	7	91	36	25	48	6
Scenario medium 15 %, per day	78	22	273	109	74	143	19
Scenario optimistic 25 %, per day	131	36	455	182	123	238	32
Number of trains per day (both direction)	24	24	24	24	12	32	8
Number of passenger per day per train	**Tallinn - Pärnu**	**Pärnu - Riga**	**Riga Central - Riga airport RIX**	**Riga airport RIX - Panevėžys**	**Panevėžys - Kaunas**	**Kaunas - Vinius**	**Kaunas - Poland**
Scenario pessimistic 5 % , per day	1,09	0,30	3,79	1,51	2,05	1,49	0,80
Scenario medium 15 %, per day	3,27	0,90	11,37	4,54	6,14	4,46	2,40
Scenario optimistic 25 %, per day	5,45	1,50	18,95	7,57	10,24	7,44	3,99

Table 27. **Rail & flight passenger traffic and passengers using rail-airport integrated services in each train (2056)**

Rail & air-flight passenger traffic and passengers using rail-airport integrated services in each train for the different time horizons



	Tallinn - Pärnu	Pärnu - Riga	Riga Central - Riga airport RIX	Riga airport RIX - Panevėžys	Panevėžys - Kaunas	Kaunas - Vinius	Kaunas - Poland
2026 - Scenario pessimistic 5 % , per day	0,52	0,14	1,62	0,80	1,11	0,72	0,19
2026 - Scenario medium 15 %, per day	1,57	0,43	4,85	2,40	3,33	2,17	0,58
2026 - Scenario optimistic 25 %, per day	2,61	0,72	8,09	3,99	5,55	3,62	0,97
2036 - Scenario pessimistic 5 % , per day	0,94	0,26	3,01	1,38	1,90	1,39	0,74
2036 - Scenario medium 15 %, per day	2,82	0,78	9,04	4,14	5,69	4,16	2,23
2036 - Scenario optimistic 25 %, per day	4,70	1,29	15,06	6,89	9,49	6,93	3,72
2046 - Scenario pessimistic 5 % , per day	1,02	0,28	3,39	1,45	1,97	1,44	0,77
2046 - Scenario medium 15 %, per day	3,05	0,84	10,17	4,34	5,92	4,32	2,32
2046 - Scenario optimistic 25 %, per day	5,08	1,40	16,94	7,23	9,87	7,19	3,87
2056 - Scenario pessimistic 5 % , per day	1,09	0,30	3,79	1,51	2,05	1,49	0,80
2056 - Scenario medium 15 %, per day	3,27	0,90	11,37	4,54	6,14	4,46	2,40
2056 - Scenario optimistic 25 %, per day	5,45	1,50	18,95	7,57	10,24	7,44	3,99

Illustration 61. **Rail & flight passengers using rail-airport integrated services in each train for the different time horizons**

The above figure shows interesting facts: according to the different Origin destination trips, the number of passengers using rail-airport integrated services remains drastically low, the highest being in year 2056, optimistic scenario about 20 passengers.

It is pointed out that the average train utilization in long-distance trains (ø seat occupation capacity: 400 seats) is quite low on some RB line sections (in simple words, lot of trains far to be fully loaded).

	Tallinn-Pärnu	Pärnu-Riga	Riga-RIX	RIX-Panevėžys	Panevėžys-Kaunas	Panevėžys-Vilnius	Kaunas-Vilnius	Kaunas-Poland
2026	17%	14%	24%	16%	34%	22%	17%	19%
2036	31%	26%	38%	28%	58%	37%	32%	30%
2046	34%	28%	40%	29%	60%	39%	33%	31%
2056	56%	51%	60%	51%	86%	47%	54%	55%

Table 28. **Operational Plan Concept for Rail Baltica railway, ETC Gauff Mobility, 2018**

As example, in year 2056, between Tallinn and Pärnu, it should be 222 passengers and among of them, 5,45 using rail-airport integrated services.